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AFCEA

15 YEARS OF PROGRESS

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Cover

The official Seal of AFCEA, as shown on the Cover, was adopted fifteen years ago when the Association was known as the Army Signal Association. It symbolizes a strong National Security through military preparedness and mobilization of both military and civilian personnel in so far as modern communications, electronics and photographic services are concerned.

DEPARTMENTS

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	RCA 2N1708	
CHARACTERISTICS	TEST CONDITIONS	LIMITS
I_{CBO}	V_{CB} = 15 volts; I_E = 0	.025 μa max.
I_{CEX}	V_{CE} = 10 volts; V_{BE} = 0.35 volts; Free-air Temp. = 100°C	15 μa max.
V_{CE} (sat.)	I_C = 10 ma; I_B = 1 ma	.22 volts max.
V_{BE} (sat.)	I_C = 10 ma; I_B = 1 ma	.9 volts max.
t_s	I_C = 10 ma; I_{B_1} = 10 ma I_{B_2} = 10 ma;	25 nano-seconds max.
t_{on}	I_C = 10 ma; I_{B_1} = 3 ma; I_{B_2} = 1 ma; V_{CC} = 3 volts	40 nano-seconds max.
t_{off}	I_C = 10 ma; I_{B_1} = 3 ma; I_{B_2} = 1 ma; V_{CC} = 3 volts	75 nano-seconds max.

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A MESSAGE FROM AFCEA'S PRESIDENT

FRANK A. GUNTHER
National President, AFCEA
President, Radio Engineering Laboratories, Inc.

BOTH THE HONOR AND responsibilities accorded me by the membership of the Armed Forces Communications and Electronics Association by my election to your Presidency are deeply appreciated. You may be assured that I shall make every effort to carry on the successful work of my illustrious predecessors, to extend the influence of the Association, and to insure its further growth on the national scene.

This year marks the Fifteenth Anniversary of the existence of AFCEA. It has made remarkable progress in attaining its aim of promoting a thorough understanding between the military and the electronics industry of the many problems faced by each in pursuit of a common goal—mutual contributions to national security by providing the finest electronic and photographic equipment in the world best suited to our military needs. This year we must take additional steps to bring this goal nearer. We must endeavor to include in our membership every person and every electronics firm, large or small, that may be involved, directly or indirectly, in the defense effort. To this end, I urge that every Chapter of AFCEA dedicate itself to the enlargement of its membership rolls of individuals as well as business firms. I am sure your efforts will be strongly supported by our excellent headquarters staff in Washington.

To every member of AFCEA I extend my greetings for the Thanksgiving Season, and express my hope that during my tenure of office I shall be privileged to meet nearly all of our members individually. My holiday greetings are tinged by the realization that our nation is faced with the most serious crisis in its history in its attempt to preserve our institutions and freedom. AFCEA must do its part in meeting this challenge. Those of us at Headquarters hope that we shall have the wholehearted cooperation and assistance of every individual and corporate member in advancing the principles for which AFCEA stands, and thus enhance our nation's security.

Editorial

DECISION!

W. J. Baird
Editor, SIGNAL
General Manager, AFCEA

The position of world leadership in which we found ourselves following World War II was neither sought nor given prior consideration. It resulted from conditions and events beyond our control. But, once saddled with it, we accepted the challenge with the full realization that we had to grow up. That is, grow up internationally to compete diplomatically and economically in an area with trained experts, fully indoctrinated in national aims and objectives. We have not done too badly for the past fifteen years in assuming our responsibilities. However, it has become increasingly more difficult to encourage a better understanding among nations and provide individual and collective security in a frustrated world. Nor have the recent developments in the United Nations made our task any easier. More precisely, they are an indication that the road ahead still is wide in scope and complex in nature. The point is that world conditions have euchred us into a strange position. At a time when the world is sitting on a powder keg, we find ourselves not only deeply involved in peaceful pursuits internationally but greatly concerned with guaranteeing our national security and domestic balance without sacrificing our common heritage.

If a second Pearl Harbor can be said to threaten on the domestic front, we have found ourselves at a second Munich in our foreign relations. The momentary enthusiasm over the alleged collaboration we were to get from Soviet Russia after the Moscow Conference in December 1945 brings back instant memories of Chamberlain's ". . . peace in our time." The "peace" which Chamberlain bought for Britain is a matter of record; so is the "collaboration" we have gotten from Russia. Here again, as in our domestic troubles, we discover an American public strongly supporting a firm foreign policy. The issues are taking definite shape. Shall Soviet Russia be permitted to pursue a policy of unabashed imperialism, walling off to all outside access the areas under her armed control, while at the same time her technicians and propaganda experts are permitted to undermine the democratic systems outside those areas? Our current foreign policy makes with a definite "NO." At the same time our spokesmen cannot but consider how far their stand will be backed by the American people and supported by our Allies. On the home front the answer is simple, it all depends on how much we, as a nation, learn that peace—like war—must be paid for. The day when we could have peace by default of foreign aggressive intentions is forever gone.

If, at these critical times, our people and their elected representatives ever decide to dodge their individual shares of the purchase price of peace, it will be war—World War III. The armed forces can do no more than perfect their equipment, training, and techniques. The American citizen must determine whether that combination is to be ample and effective or just one more shame in the lengthening of history of our blood-stained futilities. True, they have never brought us to defeat. The futility lies in the needlessly heavy cost of our military victories. Any weakness in our national potential for waging peace or war can be interpreted in terms of national psychology. National emotions must give way to sound reason. Whether we learn this in a timely effort to preserve peace and security or after we have lost both is something for the future to decide. I do not think we will wait long for this answer.

Long before the bugle calls the patriot responds. It is a privilege to be an American. More importantly an honor to accept our responsibilities.

defense communications agency

by REAR ADMIRAL WILLIAM D. IRVIN, USN
Chief, Defense Communications Agency

IN THE NOVEMBER 1960 issue of SIGNAL, a report on the Defense Communications Agency (DCA) introduced the Agency and the Defense Communications System (DCS). At that time the Agency consisted of only a Headquarters with a nucleus staff. The Defense Communications System was but a definition.

Now, one year later, the DCA is a going management activity, well on its way toward fulfilling the job assigned to it. This is a report on that year's events and achievements.

To place these achievements in proper perspective, it is in order to restate the basic responsibilities of the Defense Communications Agency and the composition of the Defense Communications System. The DCA, as an agency of the Department of Defense is charged with exercising operational control and supervision of the Defense Communications System. The DCS is comprised of all DOD world-wide, long-haul, government-owned or leased, point-to-point circuits and facilities of the three military departments and other DOD activities. In essence, the Defense Communications System combines into a single system those elements which made up the Army's STARCOM or Strategic Communications System; the Navy's NCS or Naval Communications System and thirdly, the Air Force's AIRCOM or USAF Aerospace Communications complex. It does not include tactical communications, ship-shore and air-ground facilities.

Complex, Yet Flexible

The DCS is large, dynamic and complex, yet flexible. It consist of approximately 6,600 channels, represents a plant investment cost of about 2 billion dollars and serves over 3000 "customers" in 73 countries. The overseas portion is primarily military owned and operated while within the United States, circuits are leased almost wholly from commercial common carriers. Elements of the DCS include single and multi-channel trunks utilizing HF radio, ionospheric and tropospheric scatter, microwave, and cable facilities passing voice, teletypewriter and data signals. The military departments operate and maintain their assigned portions of this global communication system under DCA operational control and supervision through a complex of DCA Communications Control Centers.

And now to turn to achievements.

The DCA plan for exercising operational control and supervision of the DCS received the approval of the Secretary of Defense early in 1961. This approval authorized the initial establishment of an interim Defense National Communications Control Center (DNCCC) at Arlington, Virginia, (co-located with Headquarters, DCA) and two Defense Area Communications Control Centers, (DACCC), one each in the Pacific and European areas. It also authorized for planning purposes, the subsequent consideration of approximately seven additional DACCCs and/or Defense Regional Communications Control Centers (DRCCCs).

The Control Centers

As indicated in my article in the November 1960 issue of SIGNAL, the Secretary of Defense had established a "target date" of nine months to get a job done. This deadline was met when the DNCCC became operational on the 6 March 1961 radio day. Limited control and supervision of the DCS thereby were initiated. The interim DNCCC immediately commenced processing system performance data based on hourly and spot reports made by 71 DCS stations on networks, circuits, channels and facilities of the DCS. These reports provide a knowledge of the status of the DCS at all times. The Control Centers know of the traffic backlogs, if any, where and to whom —conditions of circuits—status of installed equipment at some 200 switching centers throughout the world—and the status of channels allocated to the various users. With this knowledge and with that of alternate route capabilities between any two points, spare capacity and radio propagation conditions, the Control Centers restore elements and re-allocate channels according to the needs and priorities of users.

Continuous evaluation of the performance and utilization of the DCS are being accomplished so that any problem areas can be identified and corrective action taken. In this regard, a description of the DNCCC is in order. (See Figure I, page 9).

Internally, DNCCC consists of 4 major elements: input devices, a computer, displays and control facilities. The input devices are standard military teletypewriter machines used for the reception of status messages from the various operating elements of the system. These status messages consist of data concerning the state of readiness of the circuits and facilities comprising the DCS and include outage information, delays in transmission due to

traffic backlogs and important users affected by trouble in the system. Current status data is fed into a Philco 2000 computer which has been programmed with a data base consisting of a detailed inventory of the resources and operating rules of the system. Current status information interacts on the data base in the computer to automatically display key information on electronic display boards. These displays reflect the current status of the system showing whether conditions are good, marginal or poor. When the displays indicate the need for operational instructions to correct problem areas, the system supervisor issues instructions to the appropriate activity by either telephone or message. The control area contains a series of operator consoles through which the supervisor can obtain and display additional detailed information from the computer to assist in decision making.

Extension of the DCA communications control center complex occurred in June 1961 with the activation of Defense Area Communications Control Centers (DACCCs) in the Pacific and European areas. These centers are subordinate to and report to the DNCCC. They exercise operational control and supervision of DCS components in their geographical areas in the same manner as the DNCCC covers the entire world. The Pacific DACCC is located in Hawaii. The European DACCC is located at Dreux Air Base, France. A third DACCC, in Alaska, just has become operational. The establishment of these DACCCs provides control facilities which permit the DCS in their particular areas to be responsive to the changing needs of the Theater Commanders. While the DNCCC has extensive computer capability, the degree of automation for the Area Centers is based primarily on the requirements for day-to-day, close control. A contract recently has been awarded for the design, fabrication and installation of automation hardware at our DACCCs. Our time schedule calls for switchover from manual to semi-automated operations on 1 March 1963.

DCS Circuit Directory

Six additional control centers are planned for the CONUS, Labrador, Far East and UK-European areas. Full control to assure rapid, positive responsiveness to all conditions will be possible when the complete complex of 10 centers is operational. Pending the establishment of the added centers, we are continually improving the capability of the four control centers now in existence to better and more effectively control the DCS.

In order to record the communications resources basic to the exercise of operational control and management of the DCS, DCA compiled, published and distributed a Defense Communications System Circuit Directory. This compilation of government-owned and leased communications channels, circuits and trunks is the first of its kind and provides a common tool for ready identification of the DCS by all agencies. This circuit directory is being revised continually to provide current information and to include additional elements of the DCS as they become more defined.

DCA actively has participated in planning, observing and evaluating the communications aspects of many exercises and tests to determine the responsiveness, compatability and adequacy of the segments of the DCS, including those in support of Project Mercury operations. The achievements described so far have been generally in the area of Operations, but we also have been active in the fields of Plans and Programs as well as Research and Development.

Planning is going forward to reconfigure, modernize and expand the Defense Communications System through an orderly and evolutionary process to achieve even greater effectiveness and economy with greater survivability, efficiency and speed of service. The planning envisions a high degree of system integrity and true inseparability to be achieved during the period 1961 to 1964.

With the transfer of responsibility for civil defense from OCDM to the Secretary of Defense, the DCA has been actively assisting the new Civil Defense echelon in DOD in the transition on matters dealing with communications.

R&D Projects

During the past year, the Directorate of Research and Development of Headquarters, DCA has been developed into a skilled team capable of providing the requisite technological support to the Agency. Selected key technical problems were identified as high priority projects and work towards resolving them was undertaken and is continuing. Specifically, work necessary to accomplish the DCA responsibilities of reviewing and coordinating departmental R&D projects applicable to the DCS was commenced; the preparation of technical design standards for the DCS was initiated, and studies were begun leading toward recommendations for further Research, Development, Test and Evaluation (RDT&E) projects necessary for the progressive improvement of the DCS.

The design of the electronic digital computer in the Defense National Communications Control Center offers great flexibility. In addition to its normal on-line operation for the DNCCC, it has an off-line capability which we plan to use to simulate the performance of the DCS under various conditions. R&D funds have been approved to support the preparation of this simulation capability.

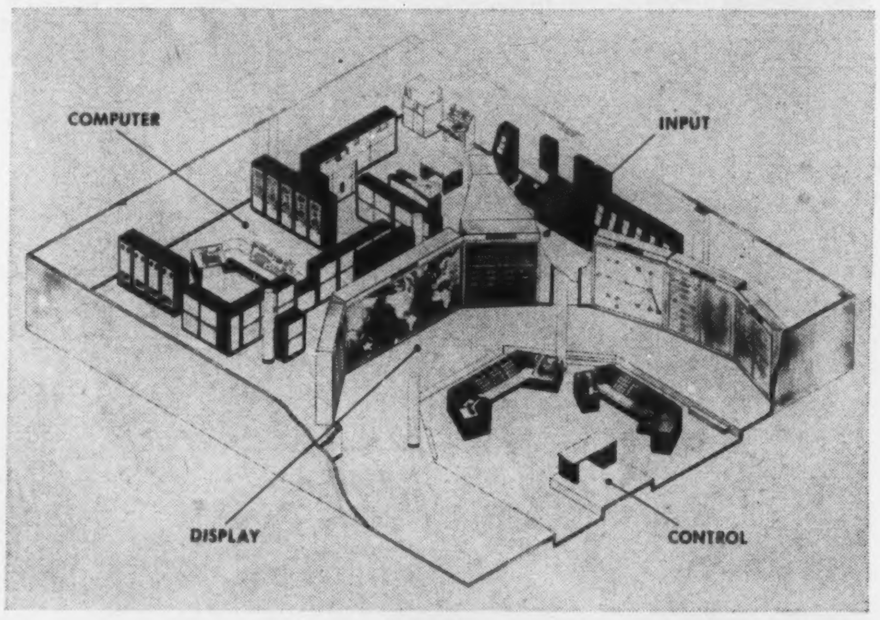


Figure 1

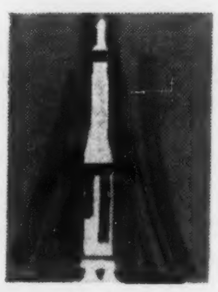
It is expected that the resulting contract will run for approximately 18 months and will permit the DCA to study and optimize the performance of the DCS through simulation of new configurations, procedures and equipment prior to recommending and effecting changes in the real-life system.

The initial integration of the individual communications facilities of the three military departments into a single Defense Communications System has opened up the capability for extensive exploitation of the military communication plant in being thereby providing Defense with heightened potentials in route diversity, spare capacity and improved service.

While proud of our achievements and developments to date, we are continually seeking ways for making useful contributions to the world-wide military posture in terms of more responsive and economical communications support.


LENKURT

TELECOMMUNICATIONS



help predict the intentions of missiles in flight

Today, at Patrick Air Force Base, test missiles that are *seemingly* off trajectory may be saved from fail-safe destruction by Range Officers through the aid of instant-to-instant information on the missile's course.

It is made possible by Lenkurt Electric's new and advanced system of quaternary data transmission that links the observation radar with the remote computer. Operating at high speed, the "Q-system" feeds the computer real-time data that affords a continuous and extremely accurate recalculation of the missile's "here-now" position in space.

The Lenkurt Quaternary Data Transmission System is a fully transistorized FM terminal that accepts serialized binary data and converts it to four-level quaternary impulses for transmission. The information rate is therefore doubled with no increase in shift rate. Under optimum conditions, the speed is 3360 bits-per-second, with error rates as low as 1 bit in a million.

This is but one more example of Lenkurt Electric's pre-eminence in the design and manufacture of telecommunications equipment.

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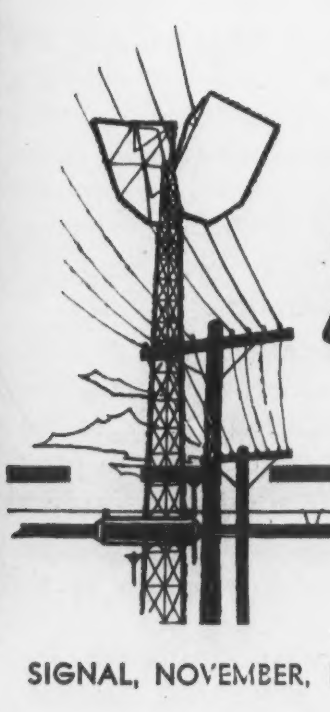

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INTERNATIONAL RELATIONS AND SPACE

by JAMES E. WEBB
Administrator
National Aeronautics
and Space Administration

THE NATIONAL Aeronautics and Space Administration's international activities began one month after the agency was organized. In November 1958, an Office of International Programs was established to plan programs and oversee their accomplishment.

In March 1959, the United States pledged that it would support projects for orbiting individual experiments or complete satellite payloads, of mutual interest, prepared by scientists of other nations. Subsequently, NASA has repeated its readiness to make available launching vehicles, spacecraft, technical guidance, and laboratory support for valid scientific experiments or payloads developed by scientists abroad. Launching vehicles provided by NASA may be one of several types, including Scout, a versatile solid-propellant, four-stage rocket capable of earth-orbiting payloads of from 50 to 150 pounds.

The first satellites under this program are being prepared by the United Kingdom and Canada. The U.K. satellite will carry devices to study electron temperatures and concentrations in the ionosphere, and instruments to determine electron densities in the vicinity of the satellite, to measure solar radiation and correlate it with ionospheric phenomena, and to observe primary cosmic rays and study their interactions with the earth's magnetic field. The payload will weigh about 170 pounds; a Scout vehicle will launch it.

Experiments were selected by scientists of the United Kingdom in consultation with NASA scientists. U.K. scientists are building the experiments. They will also be responsible for data analysis. NASA will design, fabricate, and test the prototype and flight models. Work on a second U.S.-U.K. satellite began recently.

The Canadian project centers around a "Topside Sounder" satellite, which will be employed to study the upper ionosphere by radio-echo sounding—a technique, similar to radar, used for years to study the lower portions of the ionosphere. The nature of the ionosphere makes it impossible to obtain information about its upper reaches from the ground because radar pulses penetrate the region and continue on into space instead of reflecting back to earth. The Topside Sounder will be the first attempt to apply radio-echo sounding of the ionosphere's top surface from *above*. The satellite (which has been christened "Alouette" by Canada) is being funded and built by Canada. The United States will supply the Thor-Agena launching vehicle.

The first U.K.-U.S. satellite and the Canada-U. S. Alouette will both be launched by NASA early in 1962.

Several other governments have expressed interest in cooperative satellite projects. NASA's design and test requirements for such projects call for the closest relationships between scientists of the participating nations. For example, in the satellite program with the United Kingdom, a joint U.S.-British working group meets regularly to resolve technical problems. A similar group of U. S. and Canadian scientists serves the Alouette Topside Sounder program.

Cooperative space research is by no means limited to expensive satellite projects. Much valuable information about the earth's atmospheric envelope and its near-space environment has been gained from experiments carried aloft by relatively cheap and uncomplicated sounding rockets.

NASA is cooperating with a number of nations which are conducting scientific investigations with sounding rockets. Discussions now in progress may lead to additional projects of this nature.

Typical of such programs is the

joint NASA-Italian Space Committee sounding-rocket effort. In this program rockets are used to release glowing clouds of sodium vapor at altitudes of 50 to 120 miles to measure winds and temperatures at the fringes of the atmosphere. The information obtained not only has basic scientific value but contributes as well to better understanding of basic weather phenomena.

In January and April this year, there were sodium-vapor rocket launchings from Sardinia. More are planned for the near future. During the April series, coordinated launchings were made from NASA's Wallops Island Station and the information obtained is being compared.

The Italian Space Committee purchased the rockets and built the Sardinian launching site. It conducts the launchings there, provides the instruments to gather the data, and reduces it to usable form. NASA contributed the rocket launcher, the payloads, and technical advice throughout.

Sweden and Norway also have active sounding rocket programs in which NASA is cooperating and sharing in the scientific results. Sweden recently successfully launched the first rocket in this program. The activities of Sweden are directed toward learning more about night-glowing clouds at high altitudes, while Norway plans to study phenomena of the ionosphere above northern regions.

Australia's Woomera Range is the site of a unique three-nation effort, with Australians firing British Skylark rockets carrying NASA experiments to survey sources of ultraviolet radiation in Southern Hemisphere skies.

In other joint programs under consideration, NASA may contribute the rockets and the cooperating nations the payloads, or vice versa. The method of cooperation is flexible and total costs need not be great. For this reason, sounding rocket programs will probably continue to have a large role in cooperative space activities.

Guidelines

In formulating and carrying out cooperative satellite and sounding rocket projects, NASA observes these guidelines:

1. To insure that promise does not exceed fulfillment, NASA defines proposed international projects through informal technical discussion before entering into cooperative agreements. This procedure also makes certain that projects proposed have valid scientific content so that support, related to NASA's own programs, can be provided.

2. Proposals must be specific and reflect mutual interests and capabilities. Ideally, they are for experiments or other projects that NASA itself would carry out if the project were not to be done jointly.

3. Because many individuals and agency interests are involved in space research abroad (as in this country), the importance of adequate, sustained support for costly programs requires that international projects be sponsored or supported centrally by the cooperating governments.

4. Early in the program, the role of United States financing in NASA's international programs had to be faced. It was decided that both political and scientific objectives would best be served if cooperative programs were carried out without exchange of funds between nations. Therefore, each nation funds the portion of a given cooperative program that represents commitments of its own personnel or material.

5. Scientific results of cooperative enterprises are made available to the scientific community, consistent with the interests of the prime experimenters in publishing the results of their own work.

Ground-Based Support

The most useful contribution to space research within the present capabilities of scientists abroad may for some time lie in supporting research conducted from the ground. A program of this type was arranged in connection with Project Echo. The first receipt of a transatlantic transmission from the U. S., employing Echo as a reflector, was reported by the French National Telecommunications Establishment. The first transatlantic voice message via the satellite was received in England. Suprisingly, representatives of the Soviet Academy of Sciences organized a visual tracking program and supplied a number of observations to the United States.

NASA organized a more extensive program jointly with the U. S. Weather Bureau in connection with Tiros II. Foreign weather services were invited to conduct local meteorological observations, synchronized with passes of the satellite, and to analyze and compare the data. Although Tiros II instrumentation difficulties restricted the program, an organizational precedent was established which was implemented this summer during a special nine weeks of international participation in the Tiros III satellite experiment.

NASA and the U. S. Weather Bureau planned the program to permit global meteorological observations by more than 100 weather services in synchronization with passes of Tiros III. It constitutes an important forward step toward developing an operational worldwide meteorological satellite system. In addition to this program, the Weather Bureau immediately transmits the results of its analyses of the Tiros photographs over international weather communications networks.

NASA and the Weather Bureau are also sponsoring an International Meteorological Satellite Workshop, November 13-22. Meteorologists from more than 100 foreign weather services have been invited to participate in lectures, laboratory sessions, and in visits to the Tiros satellite data receiving station at Wallops Island and to the Weather Bureau's Meteorological Satellite Laboratory.

Future Communications Satellite Experiments

Representatives of NASA, the British General Post Office, and the French Center for Communications have signed agreements for participation in NASA's coming Rebound and Relay satellite experiments. (Rebound is an advanced "passive" communications satellite of the Echo type. Relay is an "active" or "repeater" communications satellite noted earlier in this article.) The British and French organizations have agreed to construct ground terminals at their own expense for receiving and transmitting telephone, telegraph, and television signals via the satellites.

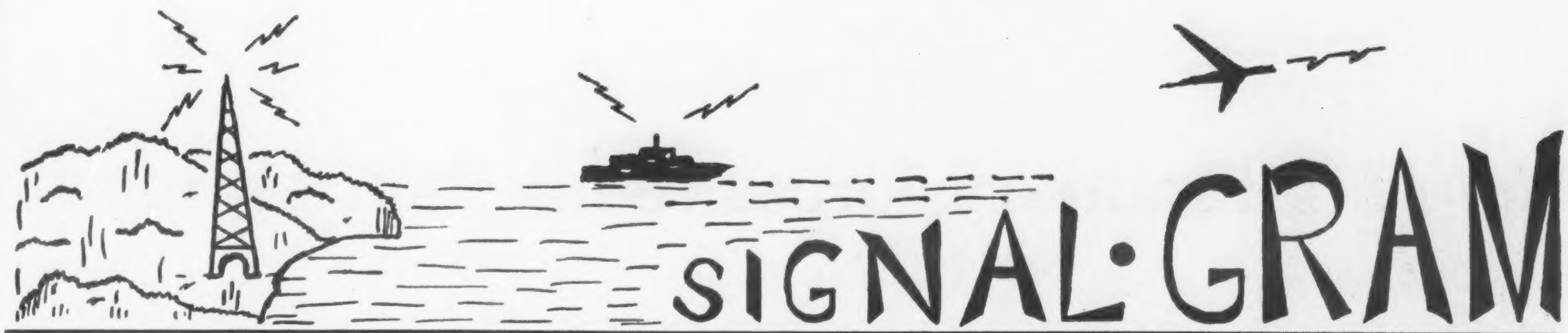
Overseas Facilities

NASA operates, or has made arrangements to use, tracking and/or communications stations in 19 foreign countries.

Of 27 overseas facilities, nearly two-thirds are operated wholly or in part by local staffs. In several cases, governments of cooperating countries are footing the entire operating costs of their units in the NASA global network. To increase this kind of participation, NASA has instituted a training program for foreign tracking and communications station technicians.

Jodrell Bank, a giant British radio telescope facility of the University of Manchester, assists NASA in space experiments, under contract. The telescope maintained contact with Pio-

(*Continued on page* 33)



—GOVERNMENT—

MILLIONS OF COPPER WIRES are forming a metallic belt some 2,100 miles above the earth's surface in the first test of Project West Ford, a passive communications system in which the copper wires act as tiny dipole antennas for reflecting radio signals back to earth. The 75-lb. scientific package containing the wire filaments was launched from Point Arguello, Calif., by an Atlas-Agena rocket on Oct. 21, 1961. The metallic belt is expected to grow at a rate of 1,200 miles a day. In about 30 days after launching, the two ends should meet. The belt is being tested for relaying high frequency signals at 8,000 mcs. between radar antennas near San Franciso and Boston. Scientists of the Massachusetts Institute of Technology's Lincoln Laboratory are conducting the experiment for the Air Force Systems Command.

7 NEW DEW LINE STATIONS have been placed in operation, the Air Force announced last month. Known as "DEW East," these Distant Early Warning stations span a 1200-mile corridor of airspace from Baffin Island in Canada, across Greenland to the Western coast of Iceland. The stations extend the electronic warning network against attack by manned aircraft and air-breathing missiles about half way across the northern reaches of the Atlantic Ocean.

DEFENSE SUPPLY AGENCY will take over the work now being carried out by the Armed Forces Supply Support Center and the Consolidated Surplus Sales Office. The establishment of the new agency was announced Aug. 31, 1961. Management of selected electrical and electronics materiel also will be placed under the agency as soon as possible, it is reported. Lt. Gen. Andrew T. McNamara, USA, who was Deputy Commanding General of the Eighth Army, heads the new agency, which will be jointly staffed. General McNamara will report directly to the Secretary of Defense.

FALLOUT SHELTER PROGRAM now in operation is designed to identify and mark spaces in existing buildings throughout the country that may be used as shelters in case of nuclear attack. The work should be completed by January 1963. It is expected that the program will identify 30,000,000 to 50,000,000 usable shelter spaces, and will provide shelter for about one-fourth of the population. Only shelter spaces which can shield 20 or more persons are being surveyed. These spaces include private as well as public buildings provided the private buildings can be made available to the general public. Family shelters in private homes are not included in the program.

CIVIL DEFENSE PLANS for conducting a nation-wide survey of fallout shelter space, and the programs for improving the warning and the radiological detection systems were outlined to several governors at a meeting of the Civil Defense Committee of the Governors' Conference. Steuart L. Pittman, recently appointed Assistant Secretary of Defense (Civil Defense), and Frank B. Ellis, Director of the Office of Emergency Planning, formerly the Office of Civil and Defense Mobilization, spoke at the Pentagon meeting held in September.

NASA VENUS PROBE now calls for the Mariner spacecraft to be launched by an Atlas-Agena B rocket. Under earlier plans, a Centaur vehicle was to be used for the mid-1962 mission to the vicinity of Venus. The change in launch vehicles is being made in the interest of increased reliability to be expected from the greater number of Atlas Agena B rockets which will have been fired before the Venus flight, the National Aeronautics and Space Administration reports. The Venus flight will provide an early test of basic equipment which will be used in later interplanetary flights.

(*Continued on page* 18)

Almost all military forces count their strength in syst

systems using Sperry electronic tubes

SPERRY
ELECTRONIC
TUBE
DIVISION

SPERRY RAND CORPORATION
GAINESVILLE, FLA.
GREAT NECK, N. Y.

Signalgram *(Continued from page 15)*

MARS TRANSFER TO AFCS was discussed at the Military Affiliate Radio System conference held Oct. 28-29, 1961, in Fresno, California. When the Air Force Communications Service was activated in July 1961, it was announced that the MARS network would become part of the new command.

NEW ARMY CHIEF OF INFORMATION is Maj. Gen. Charles Granville Dodge, formerly assistant chief of staff for reserve components, U.S. Army. General Dodge succeeds Maj. Gen. William W. Quinn, who is now deputy director of the new Defense Intelligence Agency.

ARMY INFORMATION PROCEDURES are being explained to industrial information officials as part of an Army-Industry Information Personnel Exchange Program begun last summer. The purpose for the program is to provide industry representatives with firsthand knowledge of the proper procedure for clearing technical information with the Army. The program also will allow Army information officials to study industry's methods of disseminating information. Cornell Aeronautical Lab., Inc., Motorola, Inc. and Philco Corp. are among the first companies to have their information representatives attend Army information briefings. Army information officials will be sent to study various company information procedures in the near future.

INDUSTRIAL R&D WORK amounted to $10.5 billion in 1960, a 10 percent increase over the 1959 total. This information is contained in the National Science Foundation's Reviews of Data on Research & Development, No. 30, which may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C. for 10 cents. The aircraft industry and the electrical equipment and communication industry "far surpassed" other industries in funds for research and development work in 1960, the report states. Aircraft industry received $3.5 billion and electrical equipment and communication industry obtained $2.4 billion. Of the $10.5 billion received by private industrial firms, 58 percent was financed by the Government.

AF BIOASTRONAUTICS DIV. will be the new center for all Air Force bioastronautics research and development work. The center, which will be located at Brooks AFB, Tex., will be headed by Brig. Gen. Theodore C. Bedwell, Jr. The Air Force Systems Command is in the process of consolidating various units to form the new center.

CONTRACTS: ARMY: Blount Brothers Construction Co., initial construction of National Aeronautics and Space Administration's moon rocket launch complex, $15.1 million; Research Analysis Corp., research studies including weapons systems evaluation, operations information and control systems, military economics and costing, and strategic and management systems, $4.5 million; Universal Match Corp., production of 19 Pershing guided missile launchers, $2.1 million. NAVY: Lockheed-California Co., production of Orion anti-submarine warfare planes, $92.7 million; General Dynamics Corp., continued production of advanced Terrier and Tartar supersonic guided missiles, $59.1 million; Raytheon Co., employment of additional 3,000 employees to meet special production of Sparrow III missiles, $42.4 million; General Electric Co., Heavy Military Electronics Dept., production of 11 transistorized sonar sets and associated drawings, $8.8 million; AIR FORCE: RCA Service Co., operation and maintenance services of White Alice Communications System in Alaska, $14.6 million; Republic Electronics, production of 45 single sideband radio systems, $1.7 million; General Precision Inc., production of components for instrumentation of B-58 aircraft, $1.3 million.

—INDUSTRY—

RE-ENTRY COMMUNICATIONS PROBLEMS are being investigated by scientists of Sylvania Electric Products Inc. in an effort to overcome a communications black-out caused by a "Plasma sheath.'' The plasma sheath is an electrical conductor created around high-speed re-entry vehicles by compressed and heated air. In the past, radio signals transmitted through the sheath have been substantially weakened, thus blacking out the communications link with re-entry vehicles. In the Sylvania program, small models of space vehicles are fired from a light gas gun at speeds up to 21,000 feet per second. The vehicles are launched into an evacuated tank having air pressure typical of the earth's upper atmosphere. A microwave crystal radio receiver and a telemetering transmitter in the vehicle are used to receive and send signals through a simulated plasma sheath. Resultant data is recorded on magnetic tape for evaluation and study.

IMAGE INTENSIFIER ORTHICON, a new tube which amplifies 100,000 times natural light otherwise too dim to see, was demonstrated at the Association of the United States Army meeting in Washington, D. C. in September. Developed for the Army Corps of Engineers by the Radio Corporation of America, the new electronic tube will enable field commanders to observe and direct battlefront operations without exposing troops to lights.

POCKET-SIZED RADIATION DETECTORS for registering exposures large enough to make the difference between continued normal activity and illness requiring immediate medical treatment are being supplied to the military services by Speciality Electronics Development Corp. The dosimeters, designed to be worn about the neck, register total exposure rather than the effects of single-shot contaminating experiences.

EFFECTS OF NUCLEAR EXPLOSIONS will be studied at an information center being established by General Electric Co. at Santa Barbara, Calif. Under a $211,500 contract from the Defense Atomic Support Agency, General Electric's TEMPO unit will collect, organize and report on data from all available sources on the effects of nuclear explosions at high altitudes.

RADIATION MONITORING SYSTEM will be supplied to John Hancock Mutual Life Insurance Co. by Tracerlab, Inc. The system, which will be operated by emergency electrical power facilities, will measure levels of radiation in the company's Boston shelter areas which will house some 6,000 employees in the event of a nuclear explosion.

MONSANTO RESEARCH CORP. will produce and market radioactive sources, the first of which are expected to be fabricated this month. In September the company announced that the construction of a radioactive facility and installation of equipment for the production of the nuclear sources was underway at Monsanto's Dayton, Ohio, laboratory. Initially, the facility will produce alpha and neutron sources from both polonium-210 and plutonium-239; fisson foils from neptunium, uranium and plutonium and heat sources from suitable radioactive elements.

COMPUTER PACT calling for the joint development and marketing of automatic control systems using electronic computers has been signed by Remington Rand Division of Sperry Rand Corp., and Westinghouse Electric Corp. The computers for the process control field will be used with present business data processing equipment, the firms report.

UNDERGROUND LAUNCHER SYSTEM FOR TITAN met all system requirements during the first launching of the ICBM from the test facility at Vandenberg AFB, Calif., Sept. 23, 1961. This testing of the automated vertical-lift launch capability will lead to the adding of the Titan I missile to the nation's arsenal of weapons in a state of readiness, with the missile afforded maximum protection from enemy attack while it is maintained ready for firing in a matter of minutes, it is reported. American Machine & Foundry Co. designed, developed and installed the launching system.

ATLAS ICBM COMMUNICATIONS SYSTEMS at Warren AFB, Wyo., have been completed on schedule and are currently undergoing acceptance testing by the Air Force. The intersite systems provide communications between the individual missile launch complexes and the command post at Warren. Sylvania Electric Products Inc. headed the industry team responsible for developing the systems.

SHIPBOARD RECEIVER FOR TRANSIT satellite navigation system will be developed by Westinghouse Electric Corp. Westinghouse's Electronics Division received a contract from The Johns Hopkins University, Applied Physics Laboratory for this work. Earlier the division had designed the components of the receiver set, under an APL study contract.

THIRD SUBMARINE TENDER is being constructed for use with Polaris submarines. The work is being done by the Ingalls Shipbuilding Corp., under a $24.3 million Navy contract. The new tender will issue missiles and make minor repairs to missile components. It also will have facilities for the repair of nuclear power plants in addition to normal repair and support facilities.

PUBLISHING MERGER has joined John Wiley & Sons, Inc. and Interscience Publishers, Inc. to form "one of the world's largest publishing houses" devoted to the production of books in the various fields of natural and behavioral sciences, technology and engineering. The combined enterprise will operate under the name of John Wiley & Sons, Inc., with the Interscience publishing program continuing as a distinct Wiley division. The merger adds more than 650 scientific and technical reference works to Wiley's current list of over 1800 titles in science, engineering and the social sciences.

CENTO TELECOMMUNICATIONS NETWORK will be built by Radio Corporation of America, under a $16.4 million contract from the International Cooperation Administration. The 3,060 mile network of telephone, telegraph and radio systems will link the capitals of Turkey, Iran and Pakistan. Described as an important part of the U.S. Mutual Security Program, the network connecting the Central Treaty Organization countries will be turned over to those countries, upon its completion in 1964.

VHF ANTENNA SYSTEMS will be used in tropospheric scatter experiments to determine if very high frequency communications can be used in long distance air traffic control. The Federal Aviation Agency has awarded a $230,000 contract to Page Communications Engineers, Inc. to design and provide two long distance VHF ground-air-ground antenna arrays. The VHF troposcatter mode is not affected by magnetic and solar disturbances, which sometimes have interrupted present high frequency communications.

—GENERAL—

IMPACT OF ELECTRONIC IMPORTS on United States small business component manufacturers will be studied by the Parts Division of the Electronic Industries Association, it was announced at the close of EIA's Fall Conference in New York City, Sept. 20, 1961. The group will prepare informational material aimed at developing Congressional support for a change in national policy with respect to protection of domestic industry from imports from low-wage countries, an EIA spokesman reported.

NIGHT FIGHTER-INTERCEPTOR TACTICS were televised for the first time at the World-Wide Weapon's Meet at Tyndall AFB, near Panama City, Fla., Oct. 23 to Nov. 3, 1961. Previous to this event, which is sponsored by the Air Force Air Defense Command, only the daytime missions could be covered by television. The night TV coverage is possible because of a new, all-transistorized, light-sensitive television system developed by Thompson Ramo Wooldridge. The camera televises action at light levels below that of the stars and jet exhausts of the planes and drones, according to TRW.

STANFORD UNIV. in Palo Alto, Calif. has received a $1.6 million contract renewal for continuation of a joint Navy-Air Force nuclear research project. Administered by the Office of Naval Research, the contract supports basic studies of the nuclear structure and properties of the elementary particles of nature.

RESEARCH DATA ON FUEL CELLS will be exchanged by The Electric Storage Battery Co. and Sun Oil Co. The agreement signed by The Electric Storage Battery Co., a developer of electrodes for fuel cells, and Sun Oil Co., a fuel developer also provides for the future cooperative development of fuel cells.

SATELLITE ENGINE said to be capable of operating indefinitely by battery and solar cell power was demonstrated recently by Republic Aviation Corp. The lightweight electrical engine, which obtains its thrust from an inert gas such as nitrogen, is described as "the only electrical engine in existence capable of operating today just as it will in actual use on spaceships and satellites," according to Republic officials.

INCREASED SOLAR ENERGY RESEARCH WORK should be undertaken by the Government, according to Sen. Hubert H. Humphrey (D., Minn.), who has written to the heads of several agencies and departments of the Government asking for a "full study of the existing devices and the potential application of solar energy."

MILITARY EDUCATION WITH INDUSTRY PROGRAM is providing selected Air Force officers with an insight into industrial management system concepts. Selected from all Air Force Commands, the officers spend nine months "living in" at one of the thirty-five companies participating in the program. "It is a serious, concentrated effort on the part of companies . . . to further Air Force-Industry teamwork and efficiency," one industrial official explained.

CONTINUOUS MAGNETIC FIELD of over 126,000 gauss, believed to be the most powerful ever produced, has been generated at Massachusetts Institute of Technology. The very large magnetic field was achieved in the core of a special solenoid magnet about the size of a grapefruit which was invented by Dr. Henry H. Kolm, staff member of the M.I.T. National Magnet Laboratory, and built by High Voltage Engineering Corp. under contract to Lincoln Laboratory. Such high magnetic fields are expected to make possible research in many scientific and engineering areas including those related to fusion power, superconductivity and solid state physics.

COMING EVENTS:

NOV. 13-16: Conference on Magnetism and Magnetic Materials, sponsored by American Institute of Electrical Engineers and American Institute of Physics in cooperation with Office of Naval Research, Institute of Radio Engineers, and Metallurgical Society of American Institute of Mechanical Engineers, Westward Ho Hotel, Phoenix, Ariz.

NOV. 15-17: Aerospace Electrical Society Display, Los Angeles, Calif.

NOV. 16: Annual Meeting of National Electrical Manufacturers Association, Plaza Hotel, New York City.

Big Era in Space Communications

by H. E. Weppler
Radio Engineer
American Telephone and Telegraph Company

THE NEXT 18 MONTHS will be the busiest period yet in satellite communications. So far seven experiments have been announced. When we compare this to the three communications satellites —SCORE, Echo I, and Courier— placed in orbit during the past three years, we get some idea of the quickening pace of space communications research.

Among the experiments to get under way will be the cooperative project being carried out by the National Aeronautics and Space Administration and the Bell System. This project will investigate, in space, the technological and operational problems of wideband communications via active satellites. The tests will consist of placing two such satellites in orbit and communicating via them. The first is scheduled to be launched in the spring of 1962 and the second later in the year.

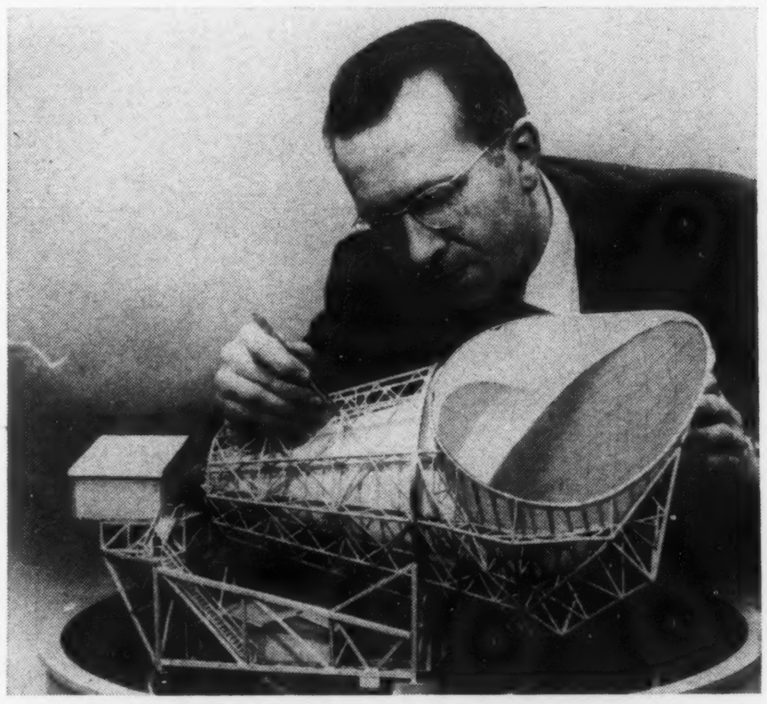
NASA's Project Relay (RCA is building the satellite) will investigate similar problems. Two launches will be made between June and December 1962.

The recently-announced Project Syncom will send a 50-pound active satellite into 22,300-mile orbit. It will not go into a true stationary orbit, but will remain roughly over the same longitude, following an elongated figure eight pattern between Latitude 33 degrees North and South. This satellite will operate on a much narrower bandwidth than the lower altitude ones and will test telephone and telegraph transmission only, not television.

Project Advent has as its ultimate goal the placing of an active satellite in 24-hour equatorial orbit. Next year, as an early part of this project, an Advent satellite will be placed in a low altitude, inclined circular orbit. This orbit, which the Advent Management Agency explains is a compromise among time, payload weight and booster capability, will be used to test the tracking, telemetry and command systems as well as the power supply and attitude control.

Such a compromise test seems desirable pending development of the necessary techniques to place in precise 22,300-mile orbit a heavy, complex active satellite and keep it on station with its antennas pointed toward earth.

Project West Ford does not involve a single satellite as its end product. It does represent a first attempt to communicate passively by reflection from a multitude of tiny resonant dipoles (Hair-like wires less than one-inch long) orbiting the earth in a belt-like formation. The dipoles were dispersed by a satellite as it orbited the earth on October 21, 1961.



Bell Telephone Laboratories engineer Alfred O. Schwarz checks model of the "world's biggest horn" which will be built this year near Rumford, Maine. The antenna, 177 feet long and housed in a "randome" 210 feet across and 161 feet high, will be used for experiments in sending television and high-speed data as well as telephone calls across the Atlantic by way of satellites. The horn rotates on two circular tracks, also turns about its horizontal axis.

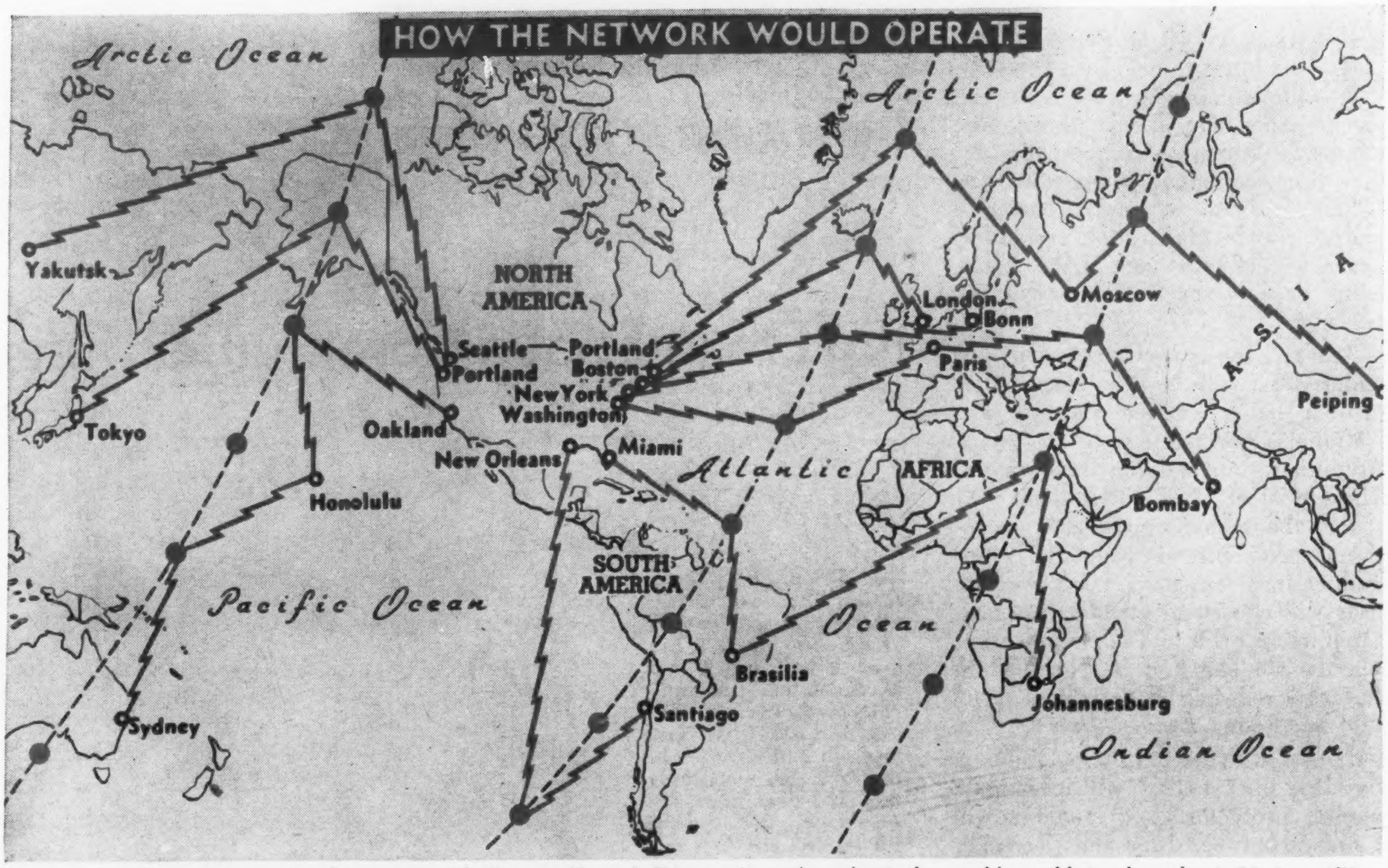
Although it is still too early to predict what form a commercial satellite system will take, the Ad Hoc Committee of International Common Carriers in its report to the Federal Communications Commission last month, noted that the choice will be made in the light of the best information available from further research and development. The Committee added that ". . . it may be feasible to establish an operational system by 1965 utilizing medium and/or high altitude satellites."

Now, for a bit of detail on the NASA -Bell System experiment which is getting under way. The two NASA-Bell System launches scheduled for April and October of 1962 have several objectives. Along with measuring transmission characteristics under conditions of orbital operation, they will check the performance of facilities currently under development for picking up and tracking the satellite and ground antenna pointing. In addition, the tests will gather information about space itself, paying particular attention to conditions affecting equipment performance over long periods of time. To accomplish this, the satellites will carry equipment for measuring radiation flux and the cumulative effect of radiation damage to semiconductor devices. Sensors on board will measure temperature and component performance.

In the joint project, NASA will be responsible for providing the rocket and arranging for the launching of the satellites. Bell will furnish the satellites and the ground station facilities and carry out the space experiments. Information gathered from these experiments will be made available to NASA. We will pay the cost of our own activities and reimburse the U. S. government for all expenses it incurs.

NASA's Goddard Space Flight Center will provide the Delta vehicle management and launch support, and minitracking and telemetry information for a period of two months after launch.

While much of the research and



The space communications network to carry telephone calls and TV programs throughout the world would involve about 26 transmitter-receiver ground installations and about 50 satellites in random polar orbits. The ground terminals might be in the general location as shown. The number of satellites will allow one satellite to be used by one pair of terminals while another satellite is being utilized by another pair.

development on an active satellite communications system can be carried out in ground-based laboratories, there are many technical problems which can only be solved by actual tests of satellites in orbit. This is why we must establish these laboratories in space. Particularly vital to the successful commercial operation of a satellite system is our ability to design reliable and long-lived electronics for the active satellites. If this cannot be attained, then satellite communications would be economically impractical. Incidentally, the working parts of an underseas cable, submerged to a depth of two miles, are almost as inaccessible as an object in outer space. Working on these cables has taught Bell System people to design and construct small parts which give trouble-free service for 20 years or longer.

To achieve the required reliability and life, it is necessary to learn more about the environmental conditions under which the electronic equipment of the satellite will operate. It is particularly urgent that we obtain more quantitative data about the intensity and the effects of the Van Allen radiation belt. It is also vital to measure the performance of components under actual temperature cycles and prolonged exposure to the high vacuum that will be encountered.

To add to this knowledge, the Bell Telephone Laboratories satellites will be launched into elliptical orbits, inclined 45 degrees from the equator and approximately 600 miles high at perigee and 3,000 miles high at apogee. They will be powered by solar cells, protected from radiation effect by thin sheets of synthetic sapphire. The planned orbit will take the satellites through the lower Van Allen belt, allowing tests to be made of satellite life and durability in that rugged environment.

TELESTAR I Size and Shape

Let us take a look at our first space laboratory. The first Bell Laboratories satellite, TELESTAR I, will be spherical in shape and weigh about 125 pounds. It will contain a single frequency-shift repeater with a 50 megacycle bandwidth. The output amplifier will be a traveling wave tube with an output of 3.5 watts. Other active components will be solid state devices. The antennas for transmitting and receiving will be located in openings which circumscribe the middle of the satellite. They will radiate nearly uniformly in all directions and have circular polarization. The satellite's minitrack beacon will have a power of about 100 milliwatts and operate in the 136-137 megacycle band. For this, it will have a multi-element spiral antenna. In addition to the solar cells, which will convert sunlight into energy, the satellite will have nickel cadmium storage batteries to furnish power while the satellite is in the earth's shadow.

TELESTAR I's communication system will operate in the top 100 megacycles of both the 4,000 and 6,000 megacycle common carrier bands. Ground-to-satellite transmission will be in the 6,000 megacycle band while satellite-to-ground transmission will be in the 4,000 megacycle band. At these frequencies and with the large ground antenna required, the radio beams will be only a fraction of a degree in width. Facilities for picking up and tracking the satellite with these narrow beams are under development at present.

Wide swing FM will be used to transmit a baseband signal of two megacycles. Tests will include the transmission of one-way television and multiplexed telephone signals. Tests will also be made transmitting two carriers through the single repeater to provide two-way telephony.

Later for an operational satellite two 50 megacycle repeaters, one for each direction of transmission, would be required to provide capacity for 600 two-way telephone conversations, or one two-way television signal. It

may also prove more economical to equip each satellite with capacity for more than one two-way broadband channel. System studies are now underway to determine the best balance between numbers of channels per satellite versus number of satellites in orbit.

Ground Station at Rumford

The Bell System is now building a ground station near Rumford, Maine. It will be ready early next year, for use in the first experiment. The installation will consist of a control station, a computer for predicting satellite positions and horn reflector antennas similar to, but much larger than, the one used in the Echo Project last year. The wideband ground transmitter and receiver will both use the same horn reflector antenna. The antenna will be 177 feet long and 94 feet high, with rotating structure of more than 315 tons of steel and aluminum. It will be protected from wind, rain and snow by a huge radome of synthetic rubber and plastic. This radome will be 210 feet across and 161 feet high.

A special maser amplifier developed by Bell Telephone Laboratories is used with the horn reflector antenna to build up the signal from the satellite. The key element in the amplifier is a ruby crystal which must be chilled to a minus 456 degrees Fahrenheit to work effectively. Handled properly, it reduces by a hundred times the lowest previous noise emitted by a receiving amplifier. At the same time, it builds up that faint signal from the satellite so that the resulting sound is loud and distinct.

With practically noise-free amplification other sources of noise, such as from the antenna, sky, atmosphere and earth, must be considered. Our experimental work with the smaller Project Echo horn-reflector antenna has shown that this type of antenna minimizes the noise caused by the earth and atmosphere.

Plans are being made to use the Rumford ground station, as well as one belonging to International Telephone and Telegraph at Nutley, N.J., in Project Relay.

Thus the months ahead will be very active in the field of space communications. It will be a period in which the United States can increase its lead in this vital area of space technology and one in which the American free enterprise system can show mankind that it is a vital, vibrant way of life dedicated to the welfare of mankind.

URGENT:

A transistorized series of vehicular-mounted radio communications equipment is shown in the above photo. Designed to meet the needs of the U. S. Army's armored, artillery, and infantry units, the system consists of a medium-powered receiver-transmitter and an auxiliary receiver and operational accessories.

MODERN ARMY COMMUNICATIONS CAPABILITY FOR LIMITED WAR

by
MAJOR GENERAL R. T. NELSON
Chief Signal Officer
U. S. Army

A SIGNIFICANT ASPECT of the nation's efforts at defense preparedness in recent months has been the new emphasis upon a limited warfare capability. Our present Signal Corps capability for providing communications support to our Modern Army in limited war is, therefore, a subject of more than usual interest.

Preparedness for limited warfare, as well as large-scale warfare, has always been a matter of primary concern to us and has loomed large in our planning. In fact, there are many Signal Corps equipments which would be needed in either eventuality. Broadly speaking, the chief effect upon Signal Corps activities of this recent shift in preparedness emphasis has been to change the proportionate quantities of things we buy. This is not to discount the effects of this policy change upon other of our activities, such as research and development, and training. An intensive reappraisal of our research and development program has been necessary, and new priorities have caused some essential revisions in our development timetables. Additionally, this policy change has required a change in training emphasis. With the more recent "build-up," our entire program has been expanded.

Preparation for Limited Warfare

Whether the emphasis at any one time be on preparedness for limited or for large-scale warfare, the Army's job is not noticeably simplified in any case. The possibility always exists that a limited or "brush-fire" war may at any time expand into warfare on a large scale. Consequently, we must always maintain a strong position of readiness for both eventualities.

Preparation for limited warfare involves consideration of a great variety of possible situations and physical conditions that extend over a very broad spectrum. At one end of this spectrum is war fought with the tactical use of nuclear weapons. At the other end is conventional war, as we have experienced in the past, but fought in the face of a constant threat that it may become nuclear at any time. In a sense, general war, with the likelihood of an all-out nuclear effort by the major powers, is less complex. Preparation for meeting the multifarious requirements of limited war under all conceivable circumstances requires meticulous planning to achieve a balanced and measured effort within a disciplinary framework of conservation of funds.

Need to Expand Communications Capability

In modern warfare, whether limited or unlimited, the problem of communications support involves expansion of our communications capability over a broader combat area. On a nuclear battlefield, wide dispersal of forces is imperative if effective military operations are to be sustained. Advancements in so-called conventional weapons in which have been achieved greater firepower, greater range, and greater mobility, have also dictated a greater dispersal of forces than ever before required. It is not likely that we will ever again find it expedient to concentrate our forces as we did in World War II.

With this evolution of our present ideas of dispersion and mobility, and the more fluid situations which these create, tactical communications requirements have skyrocketed and our reliance upon radio as a primary medium has been substantially increased. Greater mobility demands radiocommunications at lower echelons where, formerly, vocal and visual means were adequate for effective command control. To illustrate the growing reliance upon radios, a current Infantry Division, for example, is authorized 40 percent more radios of all types than an Infantry Division in 1950.

In many limited warfare situations that might be expected today, an Infantry platoon leader may see his squads on foot one day, riding in armored personnel carriers the next, and perhaps part of a helicopter airlift operation the next. Almost certainly he will find his unit maneuvering at night as frequently as during daylight hours.

To meet these new requirements of modern warfare we have developed, and are developing, a number of equipments determined to be applicable and useful in a great variety of situations. It is "not for nothing" that *versatility* is one of the established precepts in all our development endeavors. Greater reliability, ruggedness, and more mobility are other design objectives receiving equal emphasis.

New Tactical FM Radios

Notable among the new equipments we have developed to meet the requirements of greater mobility and dispersion, is a new transistorized family of tactical FM radios that provides significant capabilities over the older FM sets they replace. While these provide a substantial increase in range, we are seeking to increase radio ranges three to four times present distances by developing new scatter techniques. Perfection of these would mean a corresponding reduction in the number of radio relay stations needed, and a reduction in the density of equipments in the combat area.

In support of combat or forward-area operations, other communication facilities are being provided to meet the requirements of air defense, ground fire-control, air navigation, electronic warfare, combat surveillance, and intelligence.

Through assuring compatibility and interconnection among all of

these facilities, we have, in effect, provided for the establishment of a web-like communications complex over the entire geographical area of a field army. Serving a given area is an area communications system which is composed of multiple signal communications centers interconnected by multichannel radio and cable. By providing an "area" system consisting of multiple means and routes of communication between and among elements of the field army, the effect of destruction on one or more segments will not have the disruptive effect that it would have had on the previous "axis" system.

Flexibility in the system permits adaptation to operations of any size, and warfare of almost any type, static or mobile—limited or unlimited.

In the physical design of our equipments many changes and improvements have been made to make all of them more readily transportable. Many of the equipments capable of being transported by plane or helicopter which we have today had no air-transportable counterparts in World War II.

New miniaturization and micro-miniaturization techniques, for reducing size and weight, have progressed from component densities of 50,000 parts per cubic foot to 700,000 parts per cubic foot. Through the development of solid state devices, ultimate component densities of millions of parts per cubic foot will be achieved. By such means, nine-tenths of the soldier's equipment load can be eliminated.

Mobility and Simplification

Past efforts to lighten the soldier's communications load and to provide greater battlefield mobility are currently offering significant new advantages, not only in mobility, but in simplification of the job of logistical support, in providing faster service, and in improving our ability to establish a valid communications network under difficult conditions. In the case of our new vehicular-mounted tactical FM radios, these will replace an entire series of sets formerly used by Infantry, Armor, and Artillery. New wire communication equipments under development include an all-electronic switching system which mounts in standard Army trucks, a small push-button telephone that is transistorized and eliminates the conventional dial, and miniaturized telephone terminal sets which can be transported by fixed or rotary-wing aircraft. A pencil-thin cable and its aerial dispenscer permit aerial-laying of the cable at speeds of 100 mph.

Communication equipment mounted in helihuts—shelters capable of being carried by helicopters—and air-lifted radio stations are being developed to overcome such obstacles as mountains, rivers, and extended communication distances.

We have always placed great emphasis on tactical communications, serving as they do the "cutting edge" of our military forces. However, these forces must be supported by strategic communications extending all the way back to the seat of government. There is real urgency today that strategic means of communications be faster and more reliable than any means available to us in past emergencies. Swift and decisive actions are necessary to contain "brush-fire" wars and prevent them from spreading.

Strategic Army Communications System

Strategic communications support capability for our forces has been strengthened considerably by many recent improvements in our global network, the *St*rategic *Ar*my *Com*munications System, or STARCOM. Significant among these improvements are the new automatic relay stations with high-speed automatic switching, which have been established in the Continental United States, and the new 7741-mile Pacific Scatter Communication System extending from Hawaii to Okinawa and Taiwan, which uses new ionospheric and tropospheric scatter propagation techniques offering 99 percent reliability.

Of major concern to us in the past has been the provision of an effective means of tying the combat area communications network into the strategic or global system when combat takes place in isolated regions offering no regular or suitable commercial communications facilities. This could happen in any one of several areas around the world.

In order to provide reliable, long-range communications in such areas, we initially came up with a versatile, high speed, transportable radio communications central with an operational range of 1,000 to 2,000 miles. This was specifically geared to the quick-reaction demands of limited warfare operations and could accompany units of the ever-ready Strategic Army Corps, or STRAC, in an airlift to any kind of an area in the world where aggression might occur.

In the early part of May of this year, we unveiled a greatly improved new family of such air-transportable long-range emergency systems which will replace this earlier model. These new versions are capable of ranges of 2,500 miles, 5,000 miles, and 7,000 miles. An operational range of 7,000 miles permits direct conversations with the Pentagon, via STARCOM network, from almost any location in the world. This is possible even though it may be required to by-pass a STARCOM station which may not be operating.

The traffic capacity of our global communications network has long been of deep concern to us also, and many of our efforts have been specifically directed to increasing this capability. While present capacity could satisfactorily meet today's requirements for limited war, and to a lesser degree those for all-out-war, there is no assurance that this capability can be continued in the face of growing communications requirements. The current traffic load on STARCOM of sixteen million messages a year is, for example, 50 percent greater than the peak year of World War II.

Need for Further Integration

Present efforts at automation and further integration of all the facilities comprising the global network will substantially increase traffic capacity and offer improvements in service. Nevertheless, the possibilities offered by a supplementary system of communications satellites far exceed those promised by any other means. A communications satellite system could meet growing military requirements for capacity, speed, and reliability for several years to come. That is why Project Advent is currently receiving strong emphasis, and the project is well advanced.

In the aggregate, Signal Corps efforts for providing communications support to the Army have been on a broad front. Whether we are called upon to provide communications support in an all-out war or only in a limited engagement, we are consequently in a strong position to do either or both, and our position is improving daily.

For the strength of our position we are greatly indebted to private industry. The many facets of our research and development mission, in particular, present a most difficult challenge which the Army alone could not adequately meet with present talent and facilities. The same is true in production. In all areas, industry has backed us all the way. In any question of present military capabilities, the fine spirit of cooperation that exists between the Army-Industry team is the most necessary and heart warming phenomenon on the American scene.

MORE COMMUNICATIONS FOR DEFENSE

by THOMAS F. McMAINS
Vice President and Assistant to the President
The Western Union Telegraph Company

WE ARE MOVING rapidly into a new and challenging era of mass communication on a national and global scale. The vast mounting volume of communications in record, voice and video form, by military, civilian government and business demands expanded communication facilities of the most advanced type and design, and the best creative research and engineering talents available.

The need for such improved facilities is becoming increasingly urgent as military timetables are speeded up to meet critical defense needs.

There can be no question as to the vital importance of telecommunications for military and civil defense. The military, with forces scattered around the globe, must have advanced and superior communications of all varieties if they are to keep pace with the speed, range and complexity of modern weapons and modern warfare. Of equal importance, separate and alternate routes and systems should be continuously available if one route fails or is knocked out by sabotage or enemy action.

Any major failure of communications in time of attack could possibly be disastrous since reaction to enemy attack is measured today in seconds and minutes. A military machine which requires instant command decisions to guide it must have, at all times, instant, fail-safe communications.

The military and other government agencies are moving swiftly to strengthen their manpower, their weapons and—the key to both—communications. So, too, are we giving this action our fullest support and cooperation. Right now, Western Union is engaged in a massive program to provide new and enlarged facilities, with the necessary speed, capacity, versatility and efficiency to help meet both government and business telecommunications requirements.

In the next four years Western Union plans to spend $350,000,000 to increase the communication capabilities of the nation, both qualitatively and quantitatively. One of the significant results of its new expansion program—the largest the company has ever undertaken—will be the entry of Western Union into the voice field. This will include not only record and data communication but voice, alternate record-voice, facsimile and whatever future research may develop in the way of new telecommunication techniques and methods, including satellite communication.

One of the major projects of the expansion program is the construction, now well under way, of a new, transcontinental microwave system of modern design. To give you some idea of its scope, this system is believed to be the longest, single network of microwave construction ever undertaken at one time—5,000 route miles. The network will accommodate voice, video, facsimile and other communication services, and is being equipped with completely transistorized 600-voice-band multiplexing equipment. Engineered on a building-block basis, each voice band has the capacity to handle data at speeds of 2400 bits a second, or 3,000 words a minute.

A feature of the system is its duality of transmission which assures maximum reliability and continuity of service. While signals are transmitted over the same towers, they travel simultaneously over separate operating frequencies using separate radio equipment. At every 10 or 12 stations, electronic means are used to choose the better quality signals and flash them onward over the par-

Warmest congratulations to you and your staff on the fifteenth anniversary of SIGNAL *magazine. Over the years,* SIGNAL *has become an increasingly effective bond of communication between all AFCEA members. The magazine's continued thorough and expert coverage of the broad fields of telecommunications and electronics represents an invaluable contribution to our national progress and security. All good wishes for continued success.*

WALTER P. MARSHALL, President
The Western Union Telegraph Company

allel channels without interruption. The result is not a switched-in, standby operation but actually two separate and independent systems.

Of special importance to the military is the routing of the system. The route not only bypasses what we consider critical areas but is also laid out so that it can serve major Army, Navy and Air Force installations in the central, northeastern, and southeastern parts of the United States.

Part of the new system is already in service to meet a special Air Force requirement. The first completed section extends roughly from Los Angeles to San Francisco, with towers along the coastal mountain range of California.

The transcontinental portion of the beam system, from Los Angeles to Boston, is scheduled for completion in 1962. Construction activities are under way on various sections of this route. Extensions from the main route are planned from Kansas City to Dallas and from Syracuse to Chicago via Buffalo, Cleveland and Detroit. Additionally, the existing New York to Washington, Washington to Pittsburgh and Chicago to Cincinnati routes are being reconstructed and their capacity increased.

The continued program of expansion in 1962 comprehends a southeastern route serving Richmond, Greensboro, Atlanta, Birmingham and selected military locations. These added microwave facilities will tie in with the current construction outside of Dallas and Washington, thus providing diversity and fallback protection. It is planned ultimately to expand the transcontinental system into a complete nationwide grid, linking all important cities and defense areas.

We see Western Union's microwave expansion as a major forward step in strengthening the nation's telecommunications facilities. The construction of such an additional and separate trunk network is of prime importance since it will not only follow new routes outside of target areas but will provide ultra-modern microwave facilities with the high degree of reliability, capacity and flexibility required by military users.

An interesting historical sidelight of our beam construction is the fact that just 100 years ago, on October 24, 1861, Western Union completed the first transcontinental telegraph line at a critical time in our national history. That "bond of rapid communication" held the West in the Union, then divided by Civil War, and helped preserve for the government the West's silver and gold needed to carry on the fight of the Union armies. Now, history is repeating itself as Western Union rushes to complete a radio beam system, following closely the historic route of the first transcontinental telegraph—a new major contribution to national security.

Completion of the main transcontinental beam in 1962, with its large volume of added circuitry, will enable Western Union to initiate a new broadband switching service which should have special application for military users. This new switching system will make available, on a dial-up basis, at metered rates, not only high grade voice channels and the conventional types of telegraph, facsimile and digital data service but, in addition, channels of much greater bandwidths that may be used to transmit various types of high speed data. The broadband service is designed to meet the known requirements of both the large and small user and give each the required speed and quality of service. In effect, it is an automatic, toll, dial system that —in addition to accommodating voice—will permit the transmission of data, on a voice channel, at speeds up to 3,000 words a minute at low cost. We believe this service will meet a wide variety of military communications needs in addition to industrial requirements.

Under facility interchange agreements now being negotiated with the Bell System, Western Union can interconnect its own beam facilities with Bell System facilities to reach points off our beam routes, thus strengthening and enlarging Western Union's services and capabilites.

Air Force technicians at USAF Weather Relay Center, Suitland, Md., operating Western Union Weatherfax equipment. In foreground, maps are received. At rear, maps are transmitted to network.

New Data Communication System

Another major project of our expansion program, engineered by Western Union, and now in the process of installation for the U.S. Air Force, will be, on completion in 1962, the world's largest, most advanced data communication system. It is designed to attain a degree of speed, accuracy and reliability not hitherto achieved.

The Phase I DATACOM (COMLOGNET) system provides many new operational techniques developed jointly with the Air Force over a three-year period. Basically, the network consists of five switching centers interconnecting 450 bases, air stations, depots, contractors and other authorized installations. Each of these switching centers contains two, large solid-state computers known as communication data processers. Completely automatic, the system will have an initial daily capacity of 7 million punched cards, roughly the equivalent of 100 million words.

While designed primarily to handle digital data, Phase I DATACOM inherently will be capable of handling digital information of any type including digitalized voice and graphics. As an integral part of DCS (Defense Communications System), the system will be capable of interchanging traffic on an automatic, compatible basis with other Air Force operated DCS networks. Data originating overseas will be brought into the domestic network by Air Force operated DCS facilities at "gateway" centers.

Phase I DATACOM channels will be operated, initially, at speeds of 75, 150, 300, 600, 1200 or 2400 bauds per second. The design can accommodate inputs at speeds up to 50,000 bauds per second, assuming adequate circuit links. Automatic error detection and correction have also been engineered into the system.

An important part of Phase I

DATACOM design is direct circuit switching. Such direct interconnection can be employed when large volumes of data are to be transmitted on a point-to-point basis such as to a computer.

Most users of the system will be provided with specially designed compound terminals for card and teletype messages. There will also be magnetic tape terminals to serve digital computers, 100 card-per-minute terminals for users with large volumes of card messages, and simple teletype terminals for points which have teletype traffic only.

As to security, all channels, including trunks, will be cryptographically protected. Traffic classified higher than the security clearance of a destination terminal will be automatically rejected by the system.

Phase I DATACOM is designed to assure faster reaction time in the Air Force and the other military services' logistic support. With some 1,500,000 types of items in warehouses in thirty-nine countries, the supply process has presented a major logistics problem. The new system will make it possible to move needed equipment and supplies to virtually any place on earth in less than a day. Communication experts have called Phase I DATACOM the "ultimate system concept" in light of the present-day state-of-the-art — an achievement to which all who participated can look with pride.

Other Current Projects

Some brief references now to a few other unusual projects on which Western Union is engaged in the military area:

Speeding of command decisions is of critical importance. To help meet this need, Western Union has completed the installation of a new, emergency message automatic transmission system that will automatically flash top priority instructions and orders to military commanders in all parts of the world.

Newest addition to the nation's defenses is a nuclear bomb alarm system now being installed by Western Union in strategically important target areas throughout the country. The alarm device was developed, tested and readied for prototype testing by Western Union engineers in less than seven months. While a bomb might destroy an individual sensor, there will be several sensors in each target area. (See SIGNAL, July 1960, p. 55.)

Facsimile is also at work in national defense at many military installations throughout the country. It is being used to transmit large weather maps to 650 stations here and abroad. The network, provided by Western Union, serves the U.S. Air Force, Army, Navy, Coast Guard and civilian users. It operates on a 24-hour schedule and includes in its transmission cloud analysis based on photos taken by the TIROS weather satellites now encircling the globe.

Demonstrating the rapidly increasing maturity of facsimile transmission, more than 45 million telegrams are handled by facsimile each year over 38,000 Desk-Fax machines in the offices of customers in some 200 cities. Western Union, which pioneered in modern facsimile research and development, has more facsimile equipment in use than all the rest of the world combined.

Another major part of our expansion program is Telex, a teleprinter exchange service, which permits a user to dial other subscribers, hundreds or thousands of miles away, in eight seconds or less, and receive an identifying answer back.

The present Telex network connects 23 of the largest cities in the United States and also provides fully automatic service to Canada, Mexico, and abroad. By year-end Telex will serve 45 U.S. metropolitan areas. The Telex network, when completed, will serve the nation through exchanges in 181 metropolitan areas. Arrangements have also been concluded for the interconnection of the domestic Telex network with the overseas Telex facilities of American Cable and Radio Corporation, RCA Communications, Inc., and Western Union International. Such interconnections now provide service with practically every Telex subscriber in the world.

Western Union is now doing more work in providing defense communications and handling more complex assignments in greater volume, at a faster pace, than ever before in its long history. Its research and engineering work is devoted in totality to telecommunications. And its ability to serve is backed by an experienced, nationwide operating and service organization under a single, unified direction. The company has supplemented its own research and engineering activities with a financial interest in several research-oriented companies in electronics and related fields. It also works closely with the nation's largest electronics companies in the development and application of new telecommunications systems and advanced telecommunications technology.

Future Demands

The record shows that the military-industry team is producing new communications systems and techniques in mass, variety and capability unsurpassed by any rival power. But this is no time for complacency. The pressures of time, the swift march of events and inventions, and the forces of automation are combining to create a telecommunications explosion.

We see the growth timetable of telecommunications in this country—record and voice combined—as $12 billion or more in five years and one in excess of $16 billion—or double present volume—by 1970. And there is no assurance that this flood of words and data will not descend upon us sooner. And the flood doubtlessly will come from both government and business.

What we are facing is a revolution in communications that is destined to vastly increase man's capabilities of planning, analyzing, computing and controlling. We are preparing to meet it—and to anticipate many of the changes that will result.

Research Engineer James F. Ritchie, Western Union Project Manager for Air Force Bomb Alarm System, examines sensor unit which will flash nuclear explosion information to defense officials by means of display map shown in background.

International Relations

(*Continued from page* 13)

neer V until it was 22.5 million miles from earth. Jodrell Bank was the only tracking facility in the free world capable of receiving signals from Pioneer V's five-watt transmitter beyond about 10 million miles. It has been used to track all NASA satellites and space probes. Operation of Jodrell Bank has created wide interest abroad in the possibility of establishing advanced radio telescope programs—particularly in France, Italy, Japan, and Germany. NASA is furnishing interested foreign agencies with design suggestions for building new radio-telescope tracking facilities.

Technical Training

Scientific groups entering space research may need technical advice and experience. A post-doctoral program, funded by NASA and administered by the National Academy of Sciences, makes it possible for foreign as well as U. S. scientists to pursue space-connected projects in this country. In another program, NASA is offering laboratory support and training for extended periods to qualified scientists sponsored by their governments.

International University Program

NASA has established a new International University Program for gifted graduate students from a number of countries. They will study and conduct research in the space sciences at U. S. universities. Pilot programs have been arranged at the State University of Iowa, the University of Minnesota, the University of Wisconsin, the University of Colorado, and Columbia University. Ten to 20 students will start their projects during the 1961-62 academic year. All major U. S. universities engaged in space sciences will be invited to participate in the full program, beginning with the 1962-63 academic year and involving more than 100 foreign students.

Data and Information Exchange

Scientific data from NASA space research is circulated internationally through:

1) Dispatch of preliminary technical information to COSPAR (Committee on Space Research) shortly after rockets and satellites are launched.

2) Regular transmittal of satellite orbit and observation data through the international Spacewarn system.

3) Publication of preliminary sci-

(*Continued on page* 35)


In engineering and manufacturing AMF has ingenuity you can use......

entific results and the deposit of results in World Data Centers established during the International Geophysical Year.

4) Agreements with experimenters abroad to provide the results required.

5) Publication for world use, of telemetry calibrations where useful.

6) Exchanges of scientific personnel in support of cooperative activities.

Cooperation with International Organizations

NASA maintains close and effective liaison, either directly or through appropriate agencies, with international organizations to assure adequate consideration of United States interests and effective support for peaceful international cooperation. These organizations include the United Nations, COSPAR, NATO, and the regional organizations emerging for cooperative space efforts in Europe and Latin America.

Roles of COSPAR and the United Nations

In all NASA cooperative programs, prime experimenters are provided opportunities to publish their data. The data is made freely available through COSPAR and the World Data Centers. As an organism of the scientific community, COSPAR serves to: focus the objectives of international space research programs, provide a forum for research coordination, and supply a mechanism for exchange of the information resulting.

On a governmental level, the principal forum for international cooperation in space activities is the United Nations. In 1959, an Ad Hoc Committee of the UN recommended that the UN consider: first, how it might facilitate international cooperation in space and second, what legal problems should be given attention. The legal problems that have been suggested relate to defining the limits and use of national air space, liability for damages, claims upon celestial bodies, and the like.

Opinions differ as to whether these questions are urgent. In any case, by July 1959 the Ad Hoc Committee noted that "countries throughout the world (have) proceeded on the premise of permissibility of the launching and flight of space vehicles which were launched (during the IGY), regardless of what territory they 'passed over' during the course of their flight through outer space." The Committee concluded, "that, with this practice, there may have been initiated the recognition or establishment of a generally accepted rule to the effect that in principle, outer space, on conditions of equality, is freely available for exploration and use by all in accordance with existing or future international law or agreements."

More than 50 earth satellites have now been placed in orbit, repeatedly passing over the territory of every nation on earth. No permission was sought in advance; none was expressly given by any state.

On the extremely important question of reserving space for peaceful purposes, the United States has proposed that all nations agree to ban weapons of mass destruction from orbiting satellites. However, consideration of the entire question of space by the UN has been delayed for more than a year by differences between the East and West in organizing a permanent committee for the purpose. The issue remains deadlocked.

Through IGY and COSPAR, scientists made the first effective proposals for satellite projects and created a most important precedent. The UN, on the other hand, has so far been frustrated in its efforts to contribute to international cooperation in space activities.

Conclusion

The foregoing should clearly demonstrate the substantive nature of the United States-NASA program which is stimulating the development of space research in nearly two dozen countries throughout the world, by:

1) Providing opportunities to foreign scientists to have their own experiments flown in our rockets and satellites.

2) Enlisting the talents and skills of scientists abroad in ground-based programs directly related to U. S. orbiting experiments (especially in the highly promising fields of communications and meteorological research by satellite).

3) Enabling foreign scientists and technicians to share in the operation of most U. S. global satellite tracking stations.

4) Opening up valuable training opportunities to foreign scientists in U. S. centers and universities for work directly connected with space research projects and operations.

This type of "hard" program is essential to international cooperation in space research. For, in this most advanced of technologies, technicians must carefully evaluate all proposals and provide for implementation of the feasible and useful ones through

intimate associations, in order to meet the stringent requirements of systems compatibility.

Happily, the countries of Europe, stimulated by these opportunities and the broad technological and scientific challenges and obligations of space research, are now planning to organize substantive cooperative programs of their own. The United States welcomes these new centers of cooperation and will assist to the best of its ability in any sound scientific enterprises they may plan and in which they desire us to take part. This also holds true for Latin American and Pacific nations.

And what of the future?

NASA will continue to make available opportunities for joint projects, research, and training. New and promising international developments will follow from our communications and weather satellite programs, which are already in progress. Thus, the United States is making international cooperation in space a living fact. For the welfare of mankind, all practitioners of space research should do the same.

It is highly regrettable that opportunities for truly international cooperation in space research are hampered by the prevailing world political situation. The Soviet Union talks of the "advisability of international coordination of the efforts of all states and nations . . ." and suggests that ". . . it is natural and inevitable that the Soviet Union should rightly play the leading part in the international efforts in space research." Nevertheless, the USSR has increasingly subjected space activities to political opportunism, even attacking the completely open Tiros meteorological satellite program, although the USSR and other nations have been invited to share in Tiros cloud-cover data. Indeed, the USSR was invited to participate in the program.

In spite of the present state of affairs, NASA will continue its efforts to extend international cooperation to all nations, including the USSR. President Kennedy has pledged that "we are going to continue to attempt to engage the Soviet Union in a common (space) activity."

Science is one human activity that should be independent of political boundaries. Response to NASA's program of joint space research has proven that, if given the chance, men and women of different nations and varying social and political beliefs can collaborate scientifically with enthusiasm and with growing understanding.

by ANDREW G. HALEY
General Counsel
American Rocket Society

Space Communications and Cooperation With Iron Curtain Countries

Part I

THE BROAD implications of space communications are increasingly playing a major role in several areas of our country's foreign policy. As the international importance of a positive, well-informed American policy on space communications becomes better appreciated, the need grows for an understanding of the Communist approach to the problems involved and to the policy alternatives available to the United States.

By way of introduction to the subject matter, it would be helpful to comment on the value of space telecommunications and to explain briefly some technical considerations involved in reaching international agreements in this area.

The most obvious value of space telecommunications is its use as a basic component of any effort to explore outer space, specifically through its use in tracking, guidance and information recovery. The integrity of radio communications is as necessary to the success of a mission as is the performance of the launch vehicle itself.

One of the most serious effects of radio interference is on the guidance control of the vehicle at launch, during flight, and at re-entry. Deflection at launch can be very hazardous to both life and property. Interference during flight or on re-entry can be hazardous and, in addition, cause the loss of vital data from costly and difficult experiments. "In order to prevent an uncontrolled re-entry into the earth's atmosphere, thereby courting the danger of destruction through frictional heating, the space capsule must be detected as soon as it approaches the earth, so that it can be commanded into an appropriate 'parking orbit' prior to starting re-entry into the earth's atmosphere. After the capsule is 'parked' in this orbit, recovery forces can then be mobilized and deployed on the earth's surface to maximize the survival probability."[1] If radio control, free of interference, is not maintained, the vehicle and its inhabitants may burn up without even knowledge of what happened.

As Col. James D. Flashman, writing in SIGNAL magazine points out, "As our efforts become increasingly ambitious and costly, the opportunity for a second chance becomes proportionately less. The first try must be a success, otherwise lives may be lost, millions of dollars may have been expended wastefully, to say nothing of the loss suffered by national prestige. We must be able to track space vehicles accurately, observe their programming and record their data transmissions in the most minute detail and inject control and guidance instructions instantly at will." Col. Flashman emphasized, that without positive international regulation "virtually all our activities in space communications and electronics will be conducted in an atmosphere of calculated risk, subject to the whim of the negligent, inexperienced or inept co-user of the radio spectrum, within whose power it is to wreck completely an operation upon which the prestige of an entire nation may rest."[2]

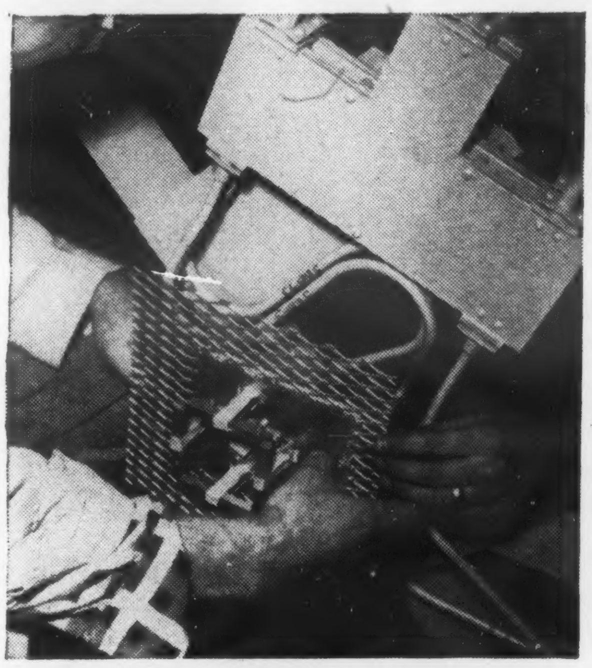
Radio Astronomy

A large but less well-known field of space communications concerns the reception of radio signals which are not man-made. This field, known as radio-astronomy, has for several years been pursued for strictly scientific purposes in an attempt to determine the age of the universe and ascertain its dynamic processes. More recently radio astronomy has promised to be of great value as a navigational aid, by enabling guidance from invisible emanations of stars not subject to optical interference from clouds or from the earth's magnetism near the poles. The tools of radio astronomy, and in particular the new 1000 foot dishes planned for the near future, are unparalleled tracking instruments, enabling communication with a 150 watt transmitter 200 million miles away in the outer reaches of the solar system.[3] Radio astronomy also enables advance prediction of geomagnetic storms so that one can better plan the study of radiation and avoid dangerous radiation during manned space flights. This prediction function also enables advance planning for communications traffic during blackouts, which is vital to national security.

A newly developing field of space communications is

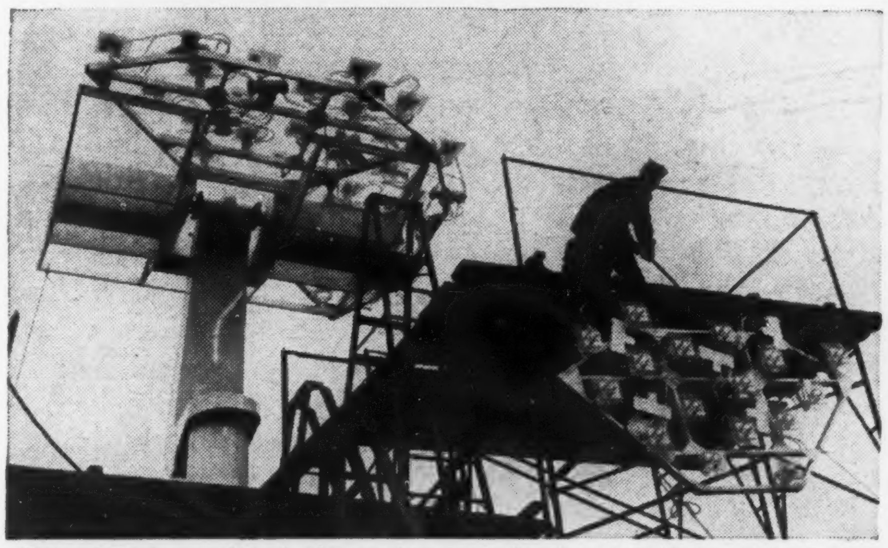
(*Continued on page* 62)

1. Murray Frank, "Outer Space—the Road to Peace," 53 pp., Committee Print of the House Committee on Science and Astronautics, 86th Congress, 2nd Session, February 1960, p. 24.
2. Col. James D. Flashman, "Positive Control of the Electromagnetic Spectrum," *Signal*, May 1959.
3. Edward Wenk, Jr., "Radio Frequency Control in Space Telecommunications," 235 pp., Committee Print of the Senate Committee on Aeronautical and Space Sciences, 86th Congress, 2nd Session, March 19th, 1960, p. 70.

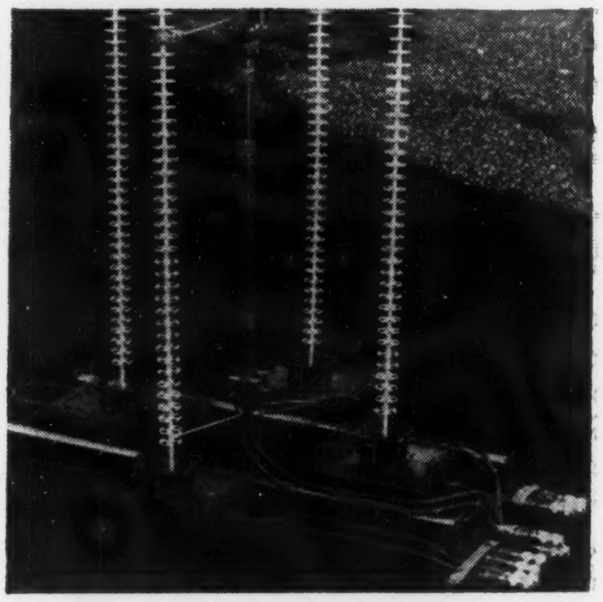


Individual unit assembly is first step in construction of antenna. Here four dipole antennas mounted on ground screen are being connected to one end of Foamflex feed lines. Special Phelps Dodge connectors are used to link the lines to the dipoles and four-way power dividers.

Completed quadrant elements, ready for placement on pedestal mount. Each quadrant is pre-assembled in exactly the same manner.



Completed quadrant elements are raised to platform for placing into position on pedestal mount.



An example of a center element unit that can be inserted into the Avien-Bogner array. This element forms a separate unit that can also be used as a portable ultra high frequency antenna.

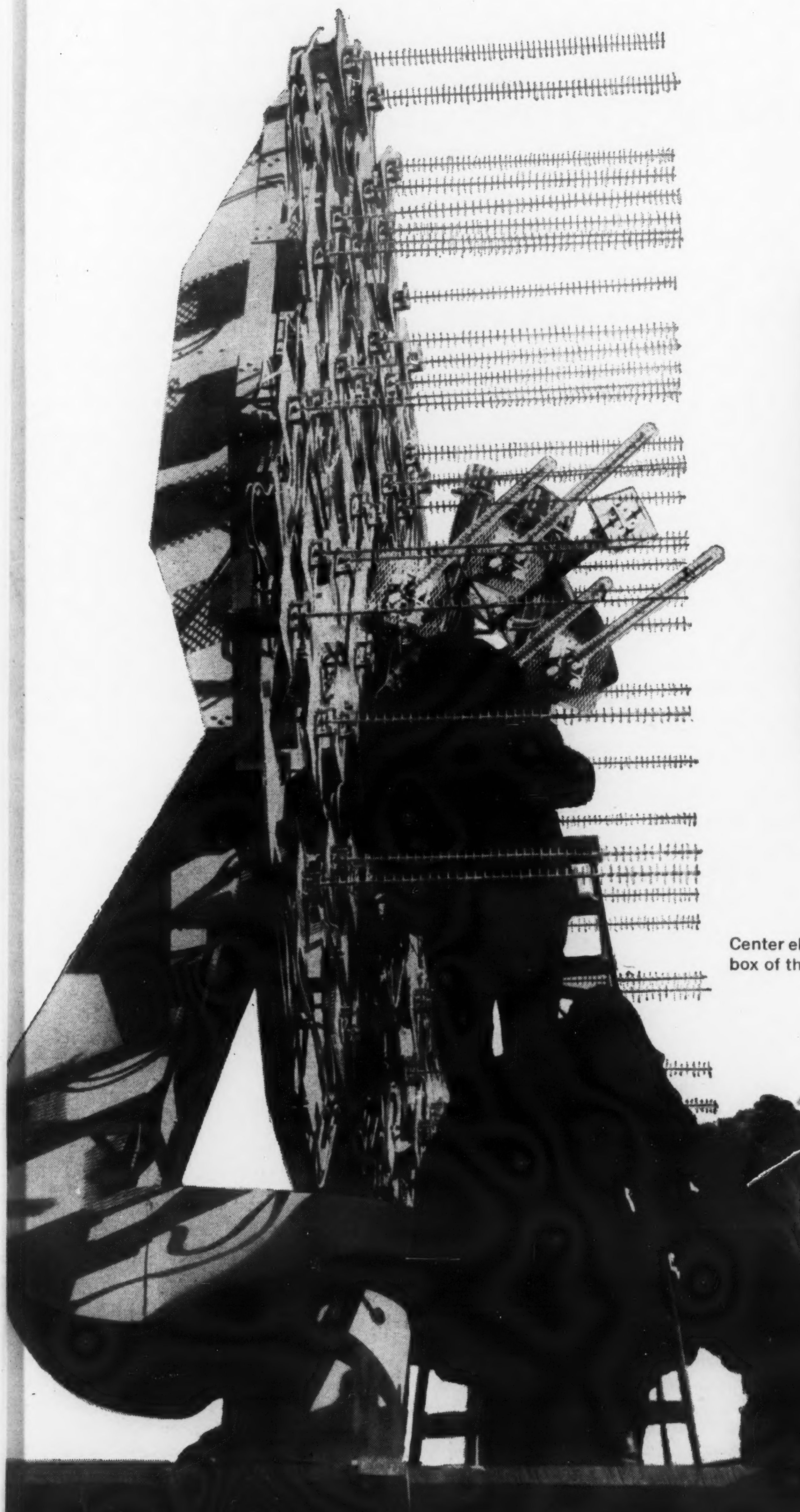
Foamflex® Coaxial Cable helps put and keep this advanced antenna system on the track!

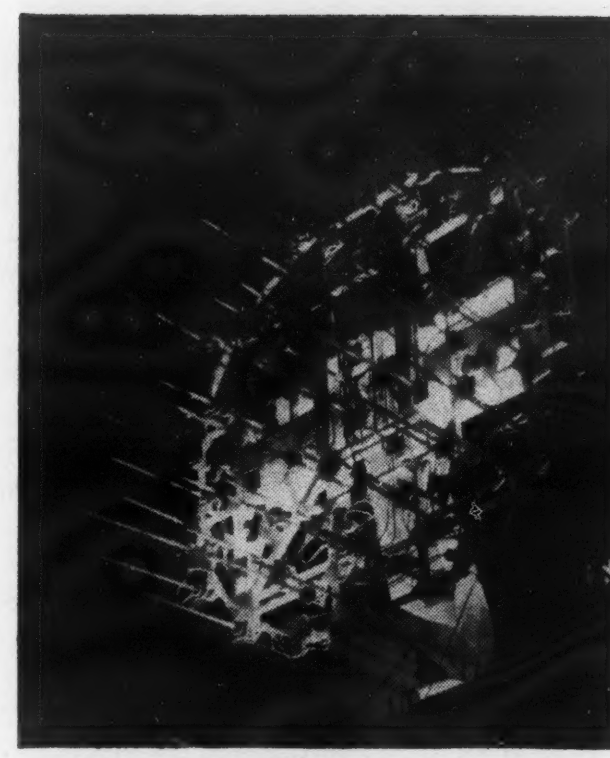
A feed network of 3/8", 50 ohm Foamflex coaxial cable is a critical part of the fully automatic Avien-Bogner acquisition and tracking antenna that represents an advance in the state of the antenna art. The efficient operation of this sensitive antenna is greatly increased by the low loss, high phase stability and electrical uniformity of its weatherproof Foamflex feed line assemblies. Special connectors, designed and fabricated by Phelps Dodge, link the Foamflex lines to double-tuned, strip-line, four-way power dividers in each quadrant element of the antenna.

Designed for Edwards Air Force Base, this modular array is assembled from identical quadrants, each equipped with power dividers, dipole antennas and cigar elements. In contrast to the heavier, fixed-type paraboloids, the lighter, smaller Avien-Bogner model costs less, yet has high acquisition capability for telemetry information through the use of three automatic tracking modes. Quadrant elements may easily be replaced when changes are desired in frequency bands, due to the simple design and construction of this antenna.

The feed system was planned, fabricated, calibrated and installed by A-T Electronics, New Haven, Conn. Accurate uniformity of electrical length for each cable was maintained from cable to cable within one degree at 2200 megacycles after bending.

The outstanding qualities of semi-flexible, aluminum-sheathed Foamflex have been proved in a number of applications where low loss, long operating life and a low noise to high signal level ratio are essential. If your specifications call for a coaxial cable of the highest efficiency, we recommend you investigate the capabilities of Foamflex.





Self-tracking Avien-Bogner acquisition array has capability to telemeter data from vehicles traveling in the far reaches of space.

Center element unit is connected to the junction box of the Avien-Bogner antenna.

Today's Challenging Requirements

by REAR ADMIRAL FRANK VIRDEN, USN
Commander
Cruiser-Destroyer Force, U. S. Pacific Fleet

THE RECENT electronics supplement of a Washington, D. C., newspaper carried a statement that the electronics industry before World War II was an infant grossing only $500 million a year. Now, according to the President of the Electronic Industries Association in the same issue, it is a husky boy of $10 billion which hopes to grow into a $20 billion man by 1970.

This growing electronics boy has deposited upon us a multi-billion dollar inventory of electronics emitters. This same technology would fain produce many multi-billions more of the same, all vying for space in the finite and very crowded frequency spectrum. The key problem of this electronics age at this point is how to fit the crowd into the spectrum.

Some interests try to solve their problem by attacking the system of frequency management. One such recently said that the system was a two-headed beast without a common brain, and that it had grown like Topsy. This gentleman is not alone in this blasting approach. It is to the great credit of National Frequency Management that complete chaos has not been allowed to develop as the destructive result of many intense pressures such as this.

As everyone is aware, we are bound in our use of communication-electronics by the provisions of the International Telecommunication Convention and the International Radio Regulations. The Geneva revisions of 1959 were ratified recently by the United States Senate. It is gratifying that this action has been completed, since ratification is of vital concern to all U.S. users of the frequency spectrum.

The Military has been working hard for many years to live within allocated parts of the spectrum. The coordination that exists in this effort is one of the best possible examples of joint cooperation. It has to be. The common good requires it. All of us have a great stake in it.

The spectre of electromagnetic chaos in the throes of standing off nuclear attack on America, leaves us no alternative but to put every possible effort into utilizing the spectrum with greatest efficiency. Frequently this must be done with equipment produced with too little emphasis on good social traits. Some equipments are frequency hogs. Let us meet the requirement to live together. Let us put major research emphasis on developing techniques to make this possible. Otherwise the building of the Tower of Babel will be enacted all over again in this Nation to our complete confusion and possible electronic strangulation. What enemy could desire more?

Another requirement today is Military Operational Compatibility. This requirement deserves close attention by researchers, makers, and operators. It provides one of the major reasons for the creation of the Defense Communications Agency (DCA).

The DCA's primary objective is establishment, operational control, and supervision of the Defense Communications System, which comprises the long haul, point-to-point systems of the Army, Navy, and Air Force. The DCA has to insure that the DCS becomes operationally compatible, and that it will stay in that condition as new developments come along. This does not mean that every function must be served with identical equipment from one end to the other. But where they meet, they have to shake hands cordially. It is up to many people in the Military and on the civilian side of the communications world to expedite this result. All military departments are bound to support the DCA in this effort. Their own statements that they do so are clearly on the record. Their implementation of these statements must be unequivocal, in the National interest.

Being a Naval Communicator, I recognize that I am not wearing the over-all Defense hat, so I will turn to matters where I work and state a purely naval requirement.

Fifteen years ago a naval aviator communicator, a real old hand, said to me, "People get worked up about all these new electronic navigation aids. They want to know what the requirement is. Well, I'll tell you. It's to know where the hell you are, *all the time*."

Even today the Naval Communications requirement is

"The Commander must be able to communicate whenever he needs to, in any mode, between and among ships separated by varying distances, and from ships to and from selected shore stations, aircraft, and satellites. He must do it in an utterly reliable, rapid, and secure way despite various kinds of disruption that may occur. With this capability in hand the Navy and National Defense will be able to realize the fullest potential of seaborne mobile forces including the capability to command and control them under any and all hazards of war and conditions less than war."

about that simple. The Commander must be able to communicate whenever he needs to, in any mode, between and among ships separated by varying distances, and from ships to and from selected shore stations, aircraft, and satellites. He must do it in an utterly reliable, rapid, and secure way despite various kinds of disruption that may occur. With this capability in hand the Navy and National Defense will be able to realize the fullest potential of seaborne mobile forces including the capability to command and control them under any and all hazards of war and conditions less than war.

Communications Systems Requirements

The system, procedures, equipment, and people provided for this purpose must not encumber its achievement. We must not regard the paraphernalia of communications as magical blessings if they happen to work. Complete reliability should be routine. Equipments which demand continuous nursemaiding in a typical shipboard environment should be cast from the fleet. They consume an enormous amount of the U. S. tax dollar and the Defense effort. The equipment has to do the job.

Here are some elements of this requirement; in listing them I am sure you will understand that plans to fulfill them are well underway already although much remains to be done.

(*a*) *Antenna Systems.* Imagine 100 transmitters and 200 receivers living together in one steel hull. Efficiency and selectivity must be high. We must transmit with higher power, receive with greater sensitivity, eliminate interaction. We must communicate from the VLF portion of the spectrum on up to several kilomegacycles, ship to ship, shore, ground, air, submarine, and satellite, and in any combination of these at any time.

Electromagnetic compatibility demands of the shipboard environment are most exacting. Antennas must survive heavy storms, high speeds under water, and heavy iceloading, and must be able to take the bumps of overhead ice and big sea animals.

Aircraft must be able to provide automatic linking regardless of flight altitude. Directional antennas must be adapted to ships for linking purposes, satellite tracking, and for high capacity ship to shore links.

(*b*) *Guaranteed Transmission Path.* We need continuous reliable frequency prediction over all radio paths, automatic frequency selection, and circuit routing responsive to the transmission path condition, higher communication rate per unit of bandwidth, error correction, automatic systems monitoring and adjustment, and voice radio security.

In sum, we need complete flexibility of control to transmit voice, printing, pictures, signals, and data with security, and without interruption. Primary emphasis must be placed on giving us radio communications in the two to thirty band as reliable as anywhere else in the spectrum or even as hard wire.

(*c*) *Mobility.* Mobility inherently means communications must have almost complete versatility, automatic switching of messages or channels, small units to compress much capability into a small ship, an airplane, a helo hut, or a van. Modular construction should reach its ultimate development in the mobility concept both for building block versatility and for instant restoral of defective devices.

(*d*) *People.* Economy of personnel is very important. Sailor operators with only rudimentary training must be able to keep their systems operating at optimum efficiency. They must have simple tell-tale devices, go, no go, and, where do I look.

We can't have hordes of operators and maintenance personnel aboard ship. We can have just a few, the majority in their first enlistment, and they must keep the operation going at top efficiency even in the furthermost waters of the world, and particularly in those waters. Equipment designed without regard for realistic shipboard personnel facts will get a black mark.

I have named a lot of elements of the problem we are working on that are specifically Naval because we have over 800 shipboard communication stations roaming the waters of the world. The world's best counterpoise and ground system is inherent in these stations, but their physical restrictions and endless motion give us unique problems. Mobility, however, is not in itself just a Navy affair; more and more, all military services are going into programs of non-fixed communications.

Significant amounts of communications must be compressible not only into ships, but into aircraft, satellites, rockets, helo huts, air transportable vans—all sorts of configurations. This portends a new military communications way of life. We are going to have to stay loose, and be able to move quickly with small packages.

And while making these packages, please don't forget the low end of the spectrum. Very Low Frequency has lots of charm, particularly for the Navy. The size problem has to be dealt with.

Command and Control

I turn now to a newly glamorous but very old requirement—Command and Control.

Command and Control is older than the Bible. It is what the commander, be he the President, or an individual commanding officer, exercises over his forces to carry out his mission. Command and Control has been dressed up lately in some hi-falutin finery that is dazzling to behold and terrifying in its complexity. A great deal of this complexity conceivably results from creating hardware systems before concepts are fully evolved. It becomes necessary to discipline into a concept some very powerful and headstrong machines. There are some wonderful people who are geniuses in these modern contraptions, but who have never had the hard discipline or practical experience of writing an estimate of the situation, writing a plan, operating a communication station or a combat information center, or commanding any forces at all.

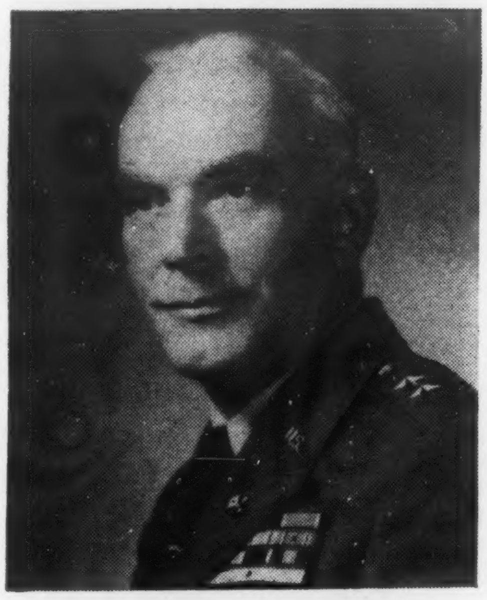
Great strides have been taken without entire regard to the relatively straightforward tasks that a commander must perform in as simple and uncomplicated way as possible, and also without entire regard to the devastation and confusion of war.

We have to find a way to transfer this kind of knowledge and experience into the copious minds of those who create Command and Control systems.

I do not try to evade the facts that reaction time has been compressed almost to the vanishing point and that weapons have been expanded to the point that they can make anything vanish. But we cannot spend our years and our Nation's fortunes making machines only to find ourselves faced with the task of bending these machines to our will before any commanding and controlling gets done. We must recognize that the machine is only as good as its input and the input depends upon people. The people demand goes up and up, in numbers, caliber, and education; and again, balance is needed. Systems include people, and people will defeat your hardware unless you design them into the system in a very practical way.

(*Continued on page* 68)

ANNIVERSARY GREETINGS FROM THE SERVICE COMMUNICATORS



Maj. Gen. R. T. Nelson
Chief Signal Officer, USA

Congratulations and all good wishes to you and your entire staff on the occasion of the 15th anniversary of the Armed Forces Communications and Electronics Association.

AFCEA has proved a real rallying-point for the military-industry team by which the difficult Signal Corps mission has been successfully accomplished. The dedication of members of AFCEA to military communications problems and the fine spirit of cooperation that exists throughout your organization is something for which all members of the U. S. Army Signal Corps are deeply grateful. It is truly one of the most reassuring aspects of the entire national defense effort.

SIGNAL Magazine, as the voice of AFCEA, has, in addition, proved a most useful forum in presenting new and thought-provoking ideas, and has served to provide a sense of direction in the fast-growing communications-electronics industry.

We, in the Army, are genuinely proud to be affiliated with AFCEA and look forward to continued cooperation with you throughout the coming years.

★ ★ ★ ★

AFCEA was born on the crest of a wave of appreciation for war's new secret weapon—electronics—now grown into an industry and grown into such proportions that the outcome of any next major war may well hinge on it. Now in its fifteenth year, AFCEA has long since become a significant institution of prime importance to the security of the Free World.

Forums such as AFCEA and SIGNAL Magazine are indispensable. Within AFCEA, industry and the military meet freely, discuss freely and exchange freely; here, the military establishments' needs and the sum of America's electronics resources are fused.

The importance of AFCEA and SIGNAL Magazine can only grow. U. S. Naval Communications congratulates the entire AFCEA membership on this Fifteenth Anniversary of the Association.

RAdm. Bernard F. Roeder, USN
Assistant Chief of Naval Operations (Communications)/Director, Naval Communications

★ ★ ★ ★

Maj. Gen. John B. Bestic, USAF
Director, Telecommunications

On the occasion of the Fifteenth Anniversary of the Armed Forces Communications and Electronics Association, may I extend my heartiest congratulations to all those who have made the Association an outstanding success.

Through the Association's unique service to the military-industry communications-electronics team, a means has been provided whereby the military and industry may accomplish their common mission with greater harmony.

The Journal of AFCEA, SIGNAL, has proven itself as an effective instrument in advancing the Air Force communications-electronics mission. By means of this publication, AFCEA members are provided with firsthand information pertaining to the Air Force communications-electronics mission; how that mission is accomplished; the problems encountered; and the goals which have been set. Armed with this information, the industry members of the team are in a position to more adequately meet Air Force requirements.

May I wish all the members of AFCEA continued success in the challenging and exciting years which lie ahead.

A 15 YEAR HISTORY OF AFCEA

With the completion of World War II, service men were headed for separation centers and an early return to civilian life. Once again the following question occupied the attention of our permanent military leaders. Would the same fatal mistake of losing that civilian-military team cooperation so essential for future preparedness again be made? The time now is May 1946 and an answer to this question, as far as communicators are concerned, is in the making. To overcome situations experienced during past periods of national industrial mobilization, both military and civilian personnel connected with the communications, electronics and photographic services of the Armed Forces planned wisely and founded an organization called the Army Signal Association. It was formed under the leadership of Major General H. C. Ingles, then Army Chief Signal Officer, who, along with the other industrial leaders, veterans of World War II, realized the necessity to continue established wartime fellowships which had developed mutual understanding of mutual problems, thus facilitating their solution. Yes, in May 1946, they envisioned a strong body of United States citizens, which, through the combined efforts of members from both industry and the military, would make certain of the future security and preparedness of the United States. This is the civilian-military team concept of which we, 15 years later, are so proud. Our Association has grown. It has become of age, but not before going through a decade and a half of maturing from boyhood to manhood.

The time now is 1961 and a presentation of the historical facts which span the time between the original Army Signal Association and the present Armed Forces Communications and Electronics Association seems appropriate.

A year by year history of this organization, which eventually became the Armed Forces Communications and Electronics Association, follows.

★ ★ ★ ★

1946

Brigadier General David Sarnoff, USAR, president of Radio Corporation of America, was selected as temporary president and other interim officers included William J. Halligan, Darryl F. Zanuck and Frederick Friendly, all of whom served as vice presidents.

General Ingles was named honorary president and Brigadier General Stephen H. Sherrill, USA (Ret.) was appointed executive secretary.

The first Association publication, a news letter called "SIGNAL Bulletin," was issued in May from National Headquarters, which had been established in Washington, D. C., first at 631 Pennsylvania Ave., N.W., then later at 804 17th St., N.W. SIGNALS, the official journal of the Association, appeared with the bimonthly September-October issue.

Seven chapters were granted charters during that first year, with New York, the first formed, followed by Fort Monmouth, Chicago, Washington, Philadelphia, Sacramento and Decatur. Oklahoma A & M became the first of the college ROTC Signal units to establish a student chapter.

General membership during the Association's initial year reached 6000.

1947

The 1st Annual Convention was held on April 28 and 29 at Fort Monmouth, N. J. At that time, announcement was made of General Sarnoff's election as president for a term of two years.

Paul Galvin, H. A. Ehle, J. Harry LaBrum, Dr. Julius A. Stratton, John J. Ott and Dr. Harold A. Zahl were selected directors of the Association for a two-year period. Named to fill the three-year terms were Carroll O. Bickelhaupt, Theodore Gary, Thomas H. A. Lewis, Thomas A. Riviere and Dr. Lee DeForest. Four-year term directors were William C. Henry, Dr. Frank B. Jewett, Frederick R. Lack, Leslie F. Muter and Charles E. Salzman.

The first presentation of the Association's Annual Award to a Signal ROTC student was made at the University of California on May 27.

Chapters chartered that year were: Cleveland, Salt Lake-Ogden, European, Richmond, Baltimore, Kentucky (re-chartered Lexington in June 1956), Pittsburgh, St. Louis, Boston, Rio and Far East (re-named Tokyo in October 1954).

1948

The name of the Association was changed in January to Armed Forces Communications Association, as a result of the unification of the services the previous year.

Offices of the national headquarters were moved to the present location, 1624 Eye Street, N. W., Washington, D. C., in February.

The 2nd Annual Convention was held May 10 and 11 at Wright Field in Dayton, Ohio.

The Decatur Chapter began an educational training course of 36 hours in electronics.

Chapters chartered that year: Seattle, Dallas, Dayton-Wright, Atlanta, San Francisco, Southern California and New York University (student chapter).

1949

Frederick Lack, vice president of Western Electric Company, was elected national president of AFCA, to succeed General Sarnoff. Mr. Lack was named at the 3rd National Convention which was held March 28 and 29 in Washington, D. C.

Chapters chartered in 1949 were: Louisiana, Augusta-Camp Gordon, South Carolina (re-activated in April 1956) and Detroit.

1950

In January, Colonel George P. Dixon, USA (Ret.) succeeded General Sherrill as executive secretary and Theodore S. Gary, vice president of Theodore Gary & Co., was elected Association president at the 4th Annual Convention which was held at New York and Fort Monmouth on May 12 and 13.

Effective with the July-August issue, the name of the official journal was changed from SIGNALS to SIGNAL.

A chapter charter was issued to Rochester.

1951

Chicago, where meetings were held on April 19 and 20, was the site of the 1951 Convention and W. J. Halligan, founder and president of Hallicrafters Company, was elected national president.

Gulf Coast, F. E. Warren-Cheyenne and Scott-St. Louis were chartered as chapters that year.

1952

At the 6th Annual Convention, held in Philadelphia on April 24, 25 and 26, W. W. Watts, vice president in charge of engineering products department, Radio Corporation of America, was named president of the Association.

Five chapters were chartered. They were: Kansas City, Memphis, San Luis Obispo, Paris and Northeastern University (student chapter).

1953

With the May-June issue, SIGNAL published its first Special Issue; it was devoted entirely to the science of photography.

At the 7th Annual Convention held in Dayton on May 14, 15 and 16, RAdm. Joseph R. Redman, USN (Ret.), vice president, Western Union Telegraph Co., was elected sixth president of AFCA.

Chapter charters were granted to Hawaii, Southern Connecticut and Tinker-Oklahoma City.

1954

The 1954 Convention was held in Washington, D. C., on May 6, 7 and 8 and was the first meeting to have military exhibits furnished by the three services. These displays stressed the use of electronics in the Armed Forces.

During this Convention, George W. Bailey, executive secretary of the Institute of Radio Engineers, became the seventh national president.

At the first mid-season directors' meeting, 29 directors of the Association met in New York on October 29. Highlight of the meeting was the unanimous decision to change the name of the Association to the Armed Forces Communications and Electronics Association. This step was the result of the necessity for intensified interest throughout the electronics field and the need for action in that direction. The vote followed a poll of the chapters which overwhelmingly favored the change.

Eight chapters were granted charters in 1954. They were: London, Johnson Air Base, South Texas, North Texas, San Juan, Cayuga, Southern Virginia and Geneva Sub-Chapter (Paris).

1955

AFCEA members held their 9th Annual Convention in New York and Fort Monmouth, N. J. There were three days of meetings, May 19, 20 and 21. George W. Bailey was re-elected AFCEA president.

AFCEA retained the services of a national advertising representative for SIGNAL.

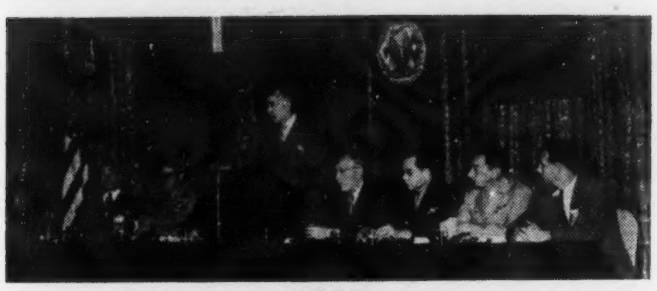
Chartered as chapters in 1955 were: Northwest Florida, Montgomery Area, Rome (Italy), Rocky Mountain, Philippine, Arizona, Rome-Utica and North Carolina.

(Continued on page 48)

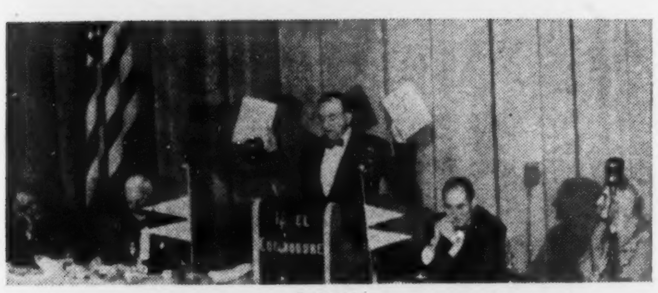
ANNUAL MEETINGS IN REVIEW

Candid Shots, 1947–1961

1947



1948



1950

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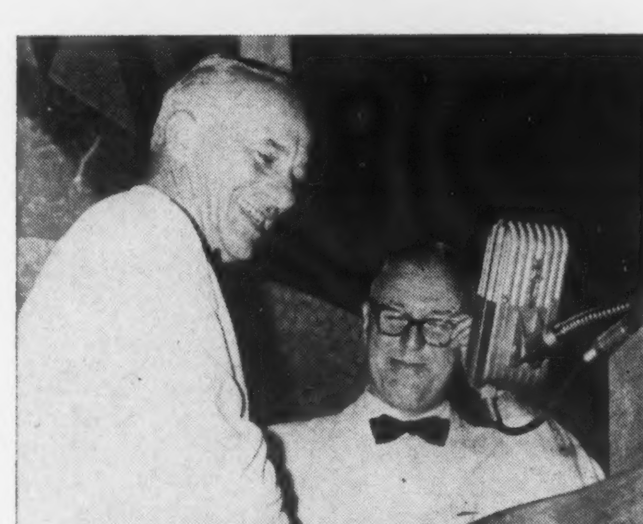

1961

1956

The first AFCEA Convention to include industry exhibits was held in Boston on May 24, 25 and 26, under the advice and guidance of W. C. Copp & Associates then serving as national advertising representatives.

Colonel Percy G. Black, USA (Ret.), Assistant Vice President, Automatic Electric Co., was elected 8th national president.

In September, Colonel W. J. Baird, USA (Ret.) joined the SIGNAL staff as editor. He replaced Colonel Dixon, who, until his death in July, served as both editor and executive vice president.

Beginning with the October issue, SIGNAL was published monthly. This device was motivated by a desire to provide a greater service to the membership. Increased advertising produced the means for greater coverage, for enlarging SIGNAL and increasing its frequency. The NEWS LETTER, which had been sent to AFCEA members each month, was incorporated into the magazine under the title SIGNALGRAM.

That year there were six charters granted. The chapters receiving them were: Korean, Central Florida, Switzerland (Geneva), Orange, Nagoya and Keflavik.

1957

In February, the Veteran Wireless Operators Association presented AFCEA an award for ten years of outstanding service in the communications-electronics field.

An editorial in the April SIGNAL announced that AFCEA lends its support to the Cooperative Interference Committee (CIC), a group to control preventable radio interference (The first CIC group was formed in 1954 in the Southern California area by Ray Meyers and Al Parker, members of the Southern California Chapter of AFCEA.) The purpose of CIC is to assist the Federal Communications Commission in the task of investigating sources of interference from devices emitting radio frequency energy and assisting in its reduction or elimination whenever practicable or possible. The work done by this group has gained nation-wide recognition.

1957's Convention was held May 20, 21 and 22 in Washington and Rear Admiral Frederick Furth, USN (Ret.), director of research and development, International Telephone and Telegraph Corporation, was named to serve as AFCEA's 9th president.

In October, Captain Wilfred B. Goulett, USN (Ret.) was named executive vice president of the Association.

A charter was issued to Frankfurt as a chapter.

1958

During the Convention which was held in Washington on June 4, 5 and 6, Admiral Furth was re-elected president for a second term.

The Association granted a chapter charter to San Diego that year.

1959

The March SIGNAL was a special issue on components, prepared in cooperation with the U. S. Army Signal Research and Development Laboratories at Fort Monmouth.

Also in March, the Board of Directors authorized a new category of corporate membership for those companies wishing to affiliate themselves with the Association. The category, known as Sustaining Membership, entitles a firm to have 35 free individual memberships in AFCEA. (The original corporate membership category, known as Group Membership, and still valid, allows for 10 free memberships.)

The Dayton-Wright Chapter began sponsorship of a three year scholarship fund at Ohio State University to stimulate the interest of young students in the electronics field.

In September, the first issue of AFCEA's Ham Membership Directory was compiled by Ray E. Meyers and made available to members.

On June 3, 4 and 5 the 13th Annual Convention was held in Washington and during this meeting, Benjamin H. Oliver, Jr., vice president of Upstate New York Telephone Co., was elected the Association's 10th national president.

Upon the resignation of Captain Goulett, AFCEA's executive vice president, Colonel Baird was appointed to the position with the title of general manager, while retaining his position as SIGNAL's editor.

Two chapters were chartered that year, Santa Barbara and Syracuse.

1960

The first meeting of the regional vice presidents was held January 29 in Chicago.

SIGNAL's special April issue, which was prepared in cooperation with the United States Navy Department, presented a series of articles dealing exclusively with the story of Naval Communications. This was the second in a series of Armed Services issues.

The Convention was held May 24, 25 and 26 in Washington and Mr. Oliver was returned to office as AFCEA president.

The June issue of SIGNAL was dedicated to saluting the U. S. Army Signal Corps on its 100th Anniversary.

"Project: Recruits for Science" was launched by the Santa Barbara Chapter in order to encourage students to pursue a scientific career.

Chapters chartered were: Cape Canaveral, Cincinnati, Okinawa, White Sands Missile Range, Marianas and Lexington-Concord.

1961

In January two new AFCEA regions were formed. They were the European and the Pacific Regions.

Third in a series of special issues about the three services was published in March; this was the Air Force Issue on Aerospace Age Communications-Electronics, compiled in conjunction with the United States Air Force.

The 15th Annual Convention was held June 6, 7 and 8 and featured over 200 industry exhibits displayed in two hotels. Expansion from one to two hotels was necessitated by increased demand for exhibit space. Convention attendance was the largest to date.

During the Annual Convention Banquet, the AFCEA Distinguished Service Awards were presented to ten national directors and past presidents. In addition, Major General Ingles, founder of AFCEA, also was presented the award.

Following the award presentation, Frank A. Gunther, president of Radio Engineering Laboratories, Inc., was introduced as the 11th president of AFCEA.

So far, four chapters have been chartered in 1961. They are: Alaska, Middle Georgia, Pensacola and Redstone-Tennessee Valley.

AFCEA CHARTER CORPORATE MEMBERS

Listed below are the names of the industrial firms and their current presidents who today continue to support all Association activities with the same purpose and desire which prompted them to become affiliated with AFCEA 15 years ago. These 62 charter corporate members sensed the importance of the civilian-military team concept for preparedness and the strengthening of our national security. Today, we salute them not only for their vision, their patriotic dedication and their service to country, but for the strength and support which they give to the aims and objectives of AFCEA. Through the years they have been joined by other leading industrial firms which have joined AFCEA with the same dedication. We are honored to list their names on page 71 of this issue.

SUSTAINING

INTERNATIONAL TEL. & TEL. CORP.
Harold S. Geneen

NEW YORK TELEPHONE CO.
Clifton W. Phalen

RADIO CORPORATION OF AMERICA
John L. Burns

WESTERN ELECTRIC CO., INC.
H. I. Romnes

GROUP

ADMIRAL CORP.
Ross D. Siragusa

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
W. H. Chase

AMERICAN RADIO RELAY LEAGUE
Goodwin L. Dosland

AMERICAN TEL. & TEL. CO.
Eugene J. McNeely

AMPHENOL/BORG ELECTRONICS CORP.
Mathew L. Devine

ARNOLD ENGINEERING CO.
Robert M. Arnold

AUTOMATIC ELECTRIC CO.
Herbert F. Lello

AUTOMATIC ELECTRIC SALES CORP.
Darwin H. Deaver

BELL TELEPHONE OF PENNSYLVANIA
Wilfred D. Gillen

BENDIX RADIO DIV., THE BENDIX CORP.
Malcolm P. Ferguson

CALIFORNIA WATER AND TELEPHONE CO.
Chester H. Loveland

CAROLINA TEL. AND TEL. CO.
H. Dail Holderness

CHESAPEAKE AND POTOMAC TELEPHONE CO.
J. B. Morrison

CINCINNATI AND SUBURBAN BELL TELEPHONE CO.
B. L. Kilgour, Jr.

COLLINS RADIO CO.
A. A. Collins

COPPERWELD STEEL CO.
James M. Darboker

CORNELL-DUBILIER ELECTRIC CORP.
Octave Blake

DIAMOND STATE TEL. CO., THE
Wilfred D. Gillen

DUKANE CORP.
G. R. Haase

EASTMAN KODAK CO.
W. S. Vaughn

ELECTRONIC ASSOCIATES, INC.
Lloyd F. Christianson

GENERAL DYNAMICS/ELECTRONICS, DIV. OF GENERAL DYNAMICS CORP.
Adm. Charles D. Horne, USN (Ret.)

GENERAL TELEPHONE AND ELECTRONICS CORP.
Leslie H. Warner

GILFILLAN BROTHERS, INC.
E. S. Phillips

HALLICRAFTERS CO., THE
Col. J. H. Rothrock USAF (Ret.)

HOFFMAN ELECTRONICS CORP., MILITARY PRODUCTS DIV.
H. Leslie Hoffman

ILLINOIS BELL TELEPHONE CO.
W. V. Kahler

INDIANA BELL TELEPHONE CO., INC.
Roy C. Echols

INSTITUTE OF RADIO ENGINEERS
Lloyd V. Berkner

LEICH SALES CORP.
D. C. Gibson, Jr.

MAGNAVOX CO., THE
Frank Freiman

MICHIGAN BELL TELEPHONE CO.
William M. Day

MOTOROLA, INC.
Robert W. Galvin

MOUNTAIN STATES TEL. & TEL. CO., THE
Walter K. Koch

NEW ENGLAND TEL. AND TEL. CO., THE
Erskine N. White

NEW JERSEY BELL TELEPHONE CO.
E. Hornsby Wasson

NORTHWESTERN BELL TELEPHONE CO.
A. F. Jacobson

OAK MANUFACTURING CO.
E. A. Carter

OHIO BELL TELEPHONE CO., THE
Walter S. Sparling

PACIFIC TEL. & TEL. CO., THE
Carl O. Lindeman

PHILCO CORP.
James Skinner, Jr.

PHOTOGRAPHIC SOCIETY OF AMERICA
Robert J. Goldman

RAYTHEON CO.
Richard E. Krafve

SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS
John W. Servies

SOUTHERN BELL TEL. AND TEL. CO.
Ben S. Gilmer

SOUTHERN NEW ENGLAND TELEPHONE CO., THE
Lucius S. Rowe

SOUTHWESTERN BELL TELEPHONE CO.
E. M. Clark

SPERRY GYROSCOPE CO., DIV. OF SPERRY RAND CORP.
C. A. Frische

SYLVANIA ELECTRIC PRODUCTS INC.
Gene K. Beare

TELETYPE CORP.
M. T. Goetz

TUNG-SOL ELECTRIC INC.
M. R. Schulte

UNITED TELEPHONE CO. OF MISSOURI
J. G. Kreamer

UNITED TRANSFORMER CORP.
S. L. Baraf

WEST COAST TELEPHONE CO.
Chester H. Loveland

WESTERN UNION TELEGRAPH CO., THE
W. P. Marshall

WESTINGHOUSE ELECTRIC CORP.
Mark W. Cresap, Jr.

WESTREX CORP., A DIV. OF LITTON INDUSTRIES, INC.
George T. Scharffenberger

WISCONSIN TELEPHONE CO.
C. E. Wampler

by J. F. McALLISTER
General Manager
Power Tube Department
General Electric Company

STATUS OF THERMIONIC CONVERTERS

THERMIONIC CONVERTERS—which convert heat directly into electricity—have become promising devices for using solar energy to produce electrical energy for missiles, satellites, and space vehicles. Serious consideration also is being given to their use as portable generators on the ground, one possibility being a light-weight generator using thermionic converters fired by gasoline burners.

The increasing attention being paid to thermionic converters by industry, and particularly by the military, is justified on two counts. First, the rapid progress in their development has brought them to the point where their power output and operating efficiency make them competitive with other energy-producing devices. Thermionic converters now have a weight-to-power ratio of 10 to 20 pounds per kilowatt. Second, thermionic converters possess certain distinct characteristics which recommend their use in specific applications.

What kind of progress has been made?

As with many of today's newest developments, the principle behind thermionic converters has long been known. They operate in much the same way as conventional vacuum tube diodes. That is, a cathode is heated, forcing electrons to boil out. These electrons flow across a space to a cooler anode. This, of course, is the same thermionic emission effect Thomas Edison discovered when experimenting with filaments for electric light bulbs in the early 1880's.

But it wasn't until 75 years later, in 1957, that another scientist, in the G.E. Research Laboratory, first announced that a practical and efficient static generator could be developed that would convert heat energy directly into electrical energy. Shortly thereafter, work on a close-spaced vacuum thermionic converter was begun, and in October 1960, General Electric became the first to place such thermionic converters on the commercial market.

Since then, continued development of thermionic converters has increased their power output and efficiency to more than ten times that of the original designs.

Two Converter Types

There are actually two major types of diode thermionic converters. Each has a different solution to the familiar problem of space charge, that cloud of electrons that forms and drifts randomly around the cathode's surface, and which limits the power density and efficiency obtainable from such electronic devices.

The vacuum converter is the earlier of these two types. It has its anode surface located extremely close to the cathode to reduce space charge effects. The desirable spacing is about 0.5 mil, or thinner than a human hair. The other and more recently developed type is the vapor converter. Here, a metallic vapor such as cesium is used to neutralize the space charge, thereby increasing the flow of electrons and consequently the useful electrical output. The cathode to anode spacing in vapor thermionic converters is about 10 mils.

Vacuum thermionic converters produce about 2 watts (0.4 watts per square centimeter) and have an efficiency of 3 to 4 per cent at a cathode temperature of 1150 degrees C. By way of comparison, vapor thermionic converters produce 23 watts of power (4.6 watts per square centimeter) and have typical efficiencies of 16 per cent at cathode temperatures of 1500 degrees C. Accordingly, the vapor design is expected to replace vacuum designs.

Work is continuing to increase these power levels and efficiencies through improved designs. But it is increasingly evident today that thermionic converters have reached the state of development where a third factor, their reliability, must be established.

As with any new device, thermionic converters must follow a fairly well-established pattern: progression from research stage into development stage; and from advanced development to design engineering to fit specific applications.

This is a story familiar to component manufacturers. Thermionic converters will follow the same pattern of development.

The next step in advancing the state of the art is the inception and funding of coordinated programs for the design, test and evaluation of thermionic converters to satisfy the requirements of specific equipments, particularly in the military and space fields. Basic to the success of such programs is the achievement of long life and high reliability, as well as improved levels of output and efficiency. Manufacturing feasibility and economy of production must be established for each design.

In anticipation of these programs, several companies have already spent considerable time and money to achieve long-life reliability. General Electric engineers, for instance, have operated a vapor thermionic converter for more than 300 hours. Further work on this problem promises to yield a 10,000 hour device.

The major obstacle to long life today is the lack of a metal-to-ceramic seal that will withstand high temperatures and be compatible with cesium vapor in this type of product. The ceramic material is used to physically separate the anode and cathode

surfaces. With present designs, converters operating at a cathode temperature of 1500 degrees C. require a metal-to-ceramic seal to operate at a temperature of 700 degrees C. For converters to operate with cathode temperatures above 1500 degrees C., the seal combination must operate at a temperature of about 1000 degrees C.

Achievement of final designs with high reliability and long life of 10,000 — and even 20,000 — hours will, of course, require production and testing in significant numbers of units. Sufficient statistical analyses of the causes of failure will provide the basis for design and production improvements, leading to acceptable standards of performance within equipment specifications.

Converter Applications

It is clear, that given increased reliability, thermionic converters would provide distinct advantages in a variety of applications. Even at their present power levels and efficiencies, which are appreciable, their inherent features suggest their use in certain specific operations.

In space applications, for instance, thermionic converters appear to be potentially the most efficient means of generating electricity in the 1 to 10 kilowatt range. Weight is a critical factor with all satellite and space components, and thermionic converters are capable of producing more kilowatts per pound than either batteries or solar cells for most space requirements.

To date, batteries and solar cells have been the prime sources of power for satellites. But future power requirements would necessitate increasing the battery size, making battery weight prohibitive.

Solar cells, on the other hand, produce very little power per unit area, and they become cumbersome as great numbers of them are combined to reach the required power levels.

Another important advantage of thermionic converters, in addition to their power-per-pound ratio, is their resistance to radiation effects. Both solar cells and thermoelectric generators, which depend on semiconductive properties to generate electricity, are more susceptible to radiation damage than thermionic converters, which use materials that allow them to operate in high levels of radiation without any serious damage to their power-producing characteristics.

While thermionic converters are not expected to completely replace solar cells or batteries, their characteristics do make them particularly suitable for two types of satellite missions.

One is in solar probes and orbits. Preliminary designs have been made for a 250-pound vehicle which would be able to survive a near approach to the sun and send back an uninterrupted stream of scientific data. A solar cell system would degrade at the high temperatures found near the sun. But thermionic converters would be able to continue operating even as the temperature increased with the satellite nearing the sun.

The second type of satellite application for thermionic converters is in low orbits, that is, within 300 to 500 miles of the earth. In this application, the satellite would be in the earth's shadow for close to half of the orbiting time. A thermionic converter system for this type of mission can be designed with an integral thermal storage system to enable the thermionic system to continue operating even after passing into the shadow of the earth.

One solar-thermionic power system near completion is a system called STEPS (for Solar Thermionic Electric Power System). The STEPS system, which is being built by General Electric for the Air Force, uses vacuum thermionic converters. The initial system, scheduled for ground testing this year, is designed to produce the equivalent of 500 watts of continuous power in a space environment. Later systems are expected to reach outputs of 3 to 10 kilowatts.

Another promising application for thermionic converters is as lightweight, portable generators. There are several characteristics of thermionic converters that make them desirable for this kind of service.

For example, thermionic converters have no moving parts. This, of course, provides a generator that has no audible and very little radio-frequency noise, a characteristic that recommends their use as silent generators for frontline battlefield and other uses. The absence of moving parts also means thermionic converters would need little if any mechanical maintenance.

Further, a number of common fuels can be used to provide the necessary heat to the converters. Apart from the sun, these fuel sources can be chemical or nuclear.

Use of chemical fuels, such as gasoline, is of particular value to the Army because of their wide availability. Proposals already have been made to develop a group of thermionic generators for field use that would be fired by the combustion of gasoline. These generators would have power ranges of 5 to 200 watts, at 6, 12, or 24 volts DC. In addition to gasoline, other fuels such as kerosene, liquid propane, and diesel oil are being considered.

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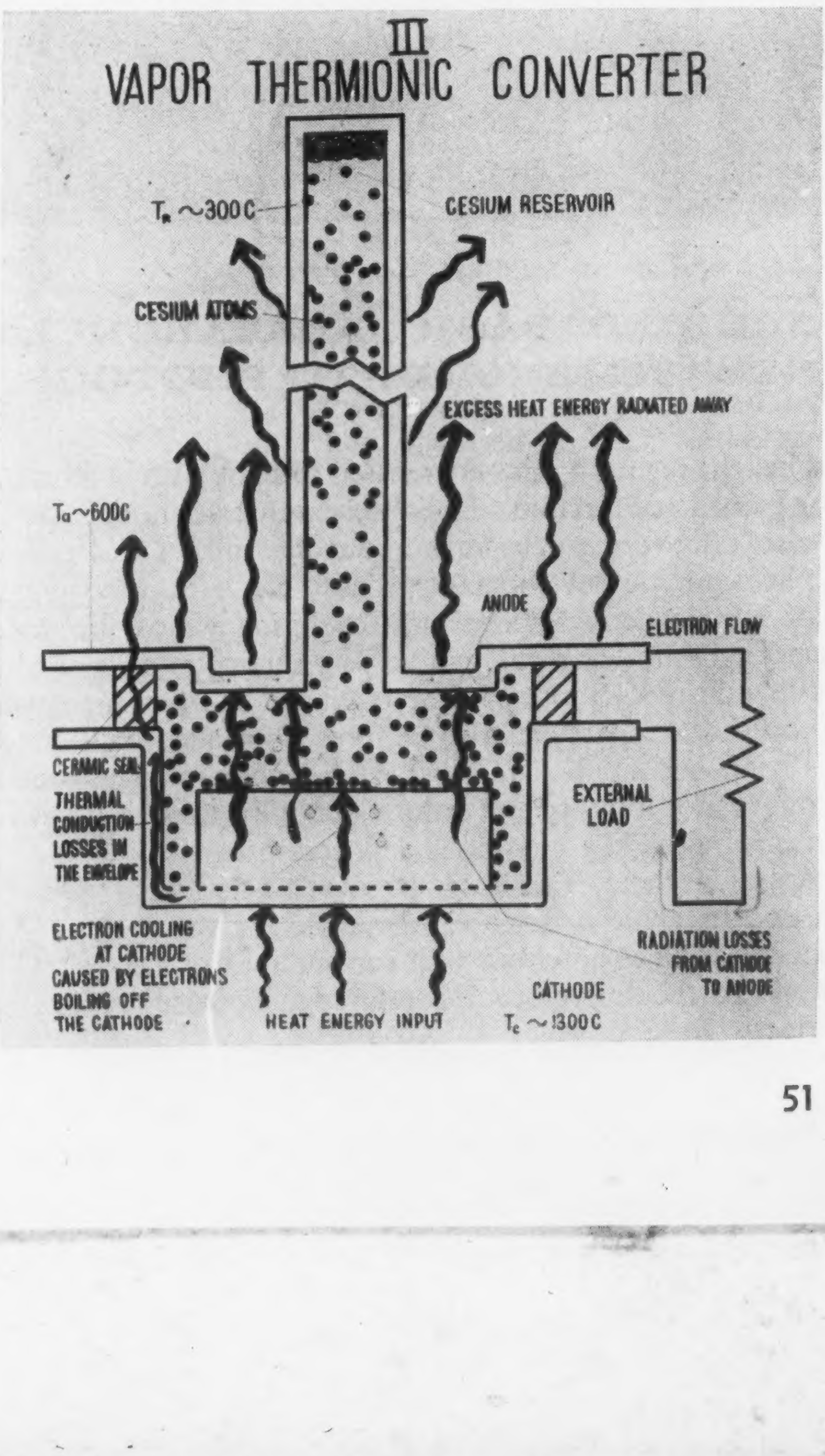
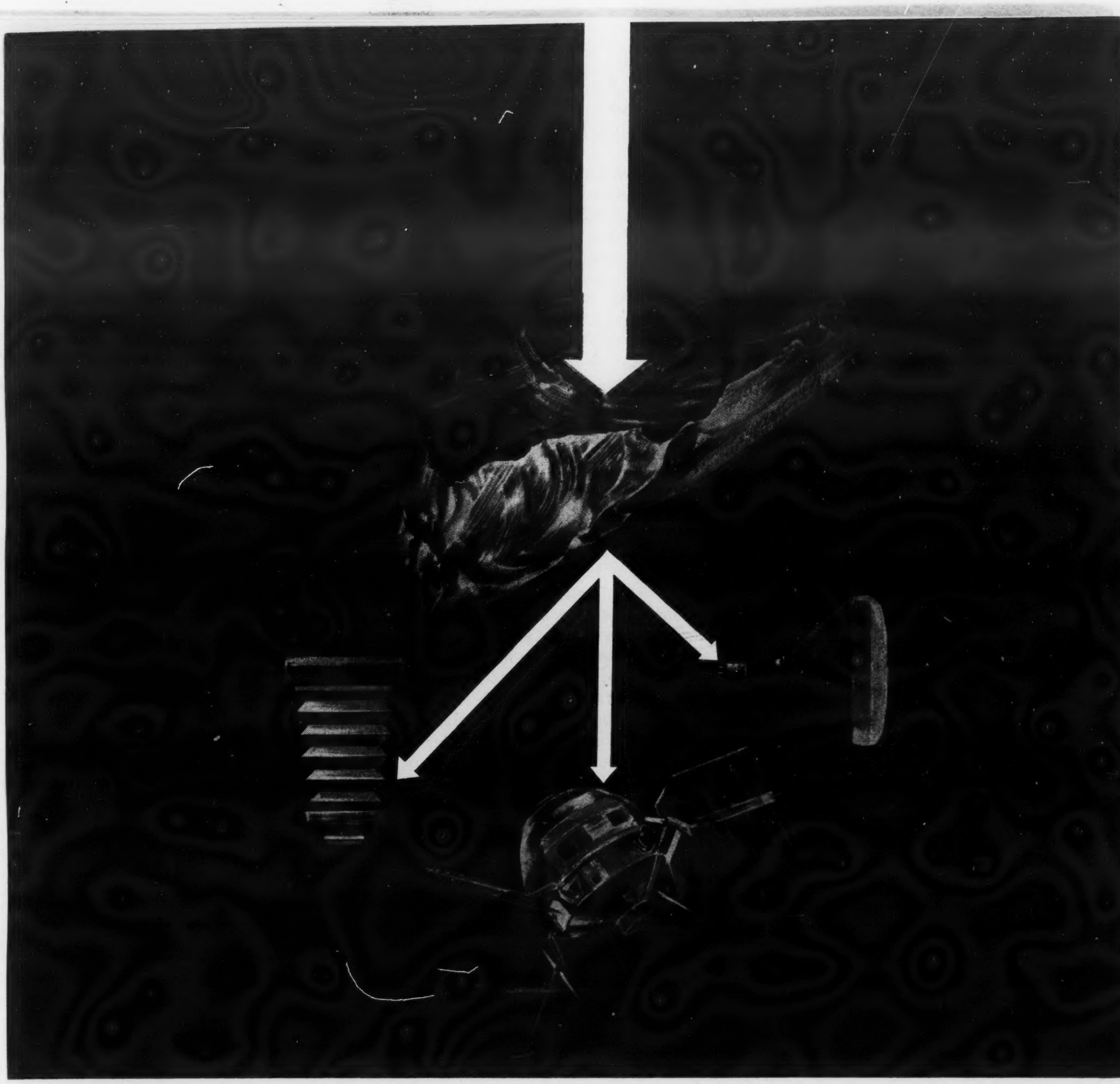


The photo at right shows diagram of operation of General Electric's vapor thermionic converter. The cesium vapor breaks down space charge to increase flow of electrons from cathode to anode. G.E. has operated its vapor thermionic converter at temperatures of about 1300°C. Power output of 10 watts and an efficiency of 11 per cent were obtained at this temperature. Operation at 1530°C. produced 23 watts of power and an efficiency of 15 to 17 per cent. The vapor thermionic converters are made by G.E.'s Power Tube Department, Schenectady, New York.



The How And Why of AFCS

by MAJ. GEN. HAROLD W. GRANT, USAF
Commander
Air Force Communications Service

On 1 July of this year, the the Air Force Communications Service became the *sixteenth* major air command.

As a command, it must have a distinctive functional role applicable to the Air Force as a whole. For AFCS, this role is to be the "single manager"— or "single operator"— of Air Force Communiations and aids to air navigation.

Let's see what this really means by going back a little in history.

The former Airways and Air Communications Service was established in 1938—as the Army Airways Communications Service. Its original charter called for it to operate a system of navigational aids to serve the needs of the Air Force as a whole. Gradually, over the 22-year period, AACS was charged with developing and operating the *long-haul* communciations for the Air Force, world-wide—sort of a "Long Lines" department for Air Force communications. By June of this year, AACS had a personnel strength of 30,000.

During this same period, however, individual commands, responding to operational requirements of their own, developed tactical communications systems to satisfy their individual needs. Most of these are in existence today, and account for an additional 22,000 people.

But look what has happened as Air Force operations became truly global: The Strategic Air Command had world-wide needs; so did the Air Defense Command. Even the requirements of the Tactical Air Command called for world-wide communications to support its composite air strike forces.

As the combat capability of the weapon systems spread around the globe, so did the needs for logistic support, administration, and all other support services. Thus, the world-wide communications needs of the separate commands began more and more to overlap.

It became obvious, as new techniques were developed, that multi-channel over-all Air Force systems might better serve the overlapping needs of many commands. Too, it was seen that a necessarily peculiar communications capability of one command might serve as well some entirely different needs of another command.

For example, it was seen that air defense communications to support northern radar installations might also serve to link northern air ground facilities required by SAC to extend its capability for airborne alert and positive control.

I could carry this idea further, but I am sure that you can see that the transition to over-all communications systems planning and thinking was brought on by the overlapping global requirements of the separate commands.

As a result of this new "systems thinking," on 1 July of this year the Air Force Communications Service was established. On that date, AFCS absorbed the facilities and personnel of the former AACS. Over the next two years, the personnel and facilities of the other major commands will be transferred to AFCS on a time-phased basis. By the end of 1963, then, AFCS will have a total personnel complement of over 50,000.

General LeMay, speaking on 1 July as part of the AFCS activation ceremonies, referred to this consolidation as follows:

". . . the re-grouping and reorienting of communications functions in the Air Force did not come about overnight. A great deal of study and evaluation took place before the details were settled. Certainly, the key requirement in our deliberation was to establish an organization that would enable the Air Force to do its job better in the years to come. AFCS will give greater *operational effectiveness* to our aerospace forces and at the same time will accrue savings in money and manpower. . . ."

Actually, the activation of the AFCS, as the *operator* of Air Force communications, came as the last of three organizational steps taken by the Air Force to improve Air Force communications management.

The first step was the creation of GEEIA—the Ground Electronics Engineering and Installation Agency—to accomplish all Air Force engineering and installation of ground communications-electronics equipment. This was established under our Logistics Command.

The second step was the establishment of what is now the Electronic Systems Division of the Systems Command—our Air Force research and development agency.

Note here that AFCS does not procure or install equipment, nor do we perform or contract for research and development. We are not, therefore, a "Signal Corps of the Air Force," as some mistakenly label us.

Although AFCS does not procure equipment, you should know that it does contract for and manage all the Air Force's leased communications. A special section of AFCS, called the Office of Commercial Communications Management, or OCCM, has been established to do this job. OCCM is presently located at Colorado Springs, but will join us at Scott AFB, Ill., by 1 January 1962.

I am pleased to be able to point out that the central leasing of Air Force communications facilities for the Air Force under OCCM has proved highly successful. So successful, in fact, that when it sets up business at Scott on 1 January, OCCM will become the single agency for leasing four million miles of private line communications for the Department of Defense as a whole—a

system whose annual telephone bill will be in excess of 180 million dollars.

This is a good place to mention AFCS's relationship to the Defense Communications Agency—a relationship which I believe you should understand.

I am often asked if AFCS doesn't duplicate the Defense Communications Agency, and if our global communications system doesn't duplicate the Defense Communications System.

Few, it seems, recognize that the Defense Communications Agency doesn't *operate* communications facilities. Each service operates its own. The aggregate of the separate services' communications capability constitutes the Defense Communications System. The Defense Communications *Agency* is an "overseer." It has operational control and over-all supervision over the *use* of these facilities—to *prevent* duplication and, generally, to insure efficient employment of all DOD communications.

The establishment of AFCS, then, was not a *duplication* of DCA, but an act to support it. AFCS provides DCA with a single point of contact for all operational matters pertaining to the Air Force portion of the Defense Communications System.

I think it important to note that Air Force communications constitute the largest communications capability of any single operating agency in the world, and comprise well over 50% of the DOD communications capability overseen by DCA.

In summarizing the *mission* of the AFCS, it may be said that this command is charged with providing the Air Force as a whole with two distinct services:

First: *World-Wide Communications.* These include everything from base telephone systems and police radio systems to global inter-base systems, all integrated into what we call the Aerospace Communications Complex, through which each Air Force operating location throughout the world may be linked.

Second: *Flight Facilities.* These are organized as a common system of enroute and terminal navigational aids and air traffic control facilities —control towers, airways stations, beacons, GCAs, etc.—deployed worldwide. I should mention that these services are coordinated with the Federal Aviation Agency, and with the International Civil Aviation Organization and the sovereign governments concerned, overseas.

You may be interested to know that to check the accuracy of these flight facilities, AFCS employs 49 aircraft. Incidentally, we will be among the first Air Force commands to receive the new Lockheed Jetstar aircraft, and will be using them for flight checking 1,784 separate facilities around the world, beginning later this year.

I would be remiss if I did not acknowledge, with pride, that a great part of our total communications capability is planned and operated jointly with industry. And, it goes without saying that every piece of equipment we use to do our job is in the end, the product of our industry-military partnership in national defense.

In regard to personnel, AFCS is unique within the Air Force—in the Department of Defense, for that matter—in several ways. Take technically qualified people, for example. Based on today's percentages, of AFCS's projected 50,000 people, approximately 80 per cent will be in highly technical skills. This compares with an average of 45 per cent for the Air Force as a whole.

Although we are widely dispersed over the world, and many of our people serve only 18 months in the United States between overseas assignments—we currently enjoy the highest personnel retention rate of any Air Force command. I believe you can conclude that AFCS is blessed with exceptionally dedicated people.

Operational & Management Improvements

Up to this point, I have told you *what* AFCS is, and *why* it has been established. In relating this to you I stated that AFCS was established to bring about improved operational effectiveness of the Air Force as a whole. I believe you would like to know the specific operational and management improvements we confidently expect.

There are eight of these, and I would like to list them for you now. They are as follows:

One: Improved operational reliability. This we can do through standardization of equipment, maintenance, and operating procedures.

Two: Improved operational flexibility. This becomes possible because as much of the total Air Force communications operating resources as necessary may be brought to bear on a single mission.

Three: Improved personnel management and career monitoring for the critically short supply of communications-electronics people. This becomes feasible now because most of the communications operating personnel will be in one command.

Four: Improved input to the Air Training Command. As prime employer of communications operating personnel, AFCS can test and evaluate the output of the communications schools, and can recommend needs of the future. We maintain a liaison staff full-time at Keesler AFB to do this for us.

Five: Improved "systems thinking" input to the Air Force Systems Command. This we can do because AFCS will be a prime planner for future communications systems. We have established a special detachment at Hanscom AFB to provide close liaison with the Systems Command.

Six: Improved user/supplier type liaison with the communications industry. This will be possible because AFCS, as the prime *user* of communications equipment, will be the major source of communications operating experience.

Seven: Improved responsiveness to the Defense Communications Agency. This is assured, as I mentioned, because AFCS will be a single point of contact for all Air Force communications operations.

And, Eight: Improved responsiveness to the needs of individual commanders. This we can guarantee through our organizational structure and management procedures.

Included in the "total communications capability" I have described are individual responsibilities which are not too well known. Many of these are interesting and unusual. As time allows, I should like to tell you about a few of them.

Few people know, for example, that AFCS has the responsibility for insuring contact with the President's aircraft—which is known as "Air Force One." On each of the Presidential flights, we receive an operations order from Headquarters USAF describing the route and the communications requirements.

Responsibility for training and inspecting *Reserve Forces* communications units is another of our tasks. It is a responsibility to which we are devoting a great deal of immediate attention—in light of current world affairs.

Communications in support of Project Mercury is also an essential part of our program. I will mention only that the National Aeronautics and Space Administration calls upon AFCS to provide access to our worldwide facilities for many phases of this project, including capsule recovery operations.

Berlin, of course, is of special interest today. AFCS has a group of people on duty at Tempelhof Central Airport in the American Sector of

(*Continued on page* 56)

West Berlin—primarily for air traffic control. In the Berlin complex, we operate more than twice the average number of navigational aids for such an area. This is necessary to insure that all Allied air traffic is kept within the "narrow" 20-mile wide limits of those three air corridors you are hearing so much about in the news.

Another of our more interesting and unusual responsibilities is to provide what is called *Emergency mission support.* This term describes our capability to provide mobile communications and flight facilities whenever and wherever it is not practical to provide permanent facilities. While this is primarily a war-time capability, we *do provide* mobile facilities to support peacetime emergencies, maneuvers, and special events.

A special adaptation of this mobile communications concept is found in project "Talking Bird." A "Talking Bird" is a C-130 aircraft which can be equipped with all sorts of prepositioned telecommunications equipment in a minimum of time and dispatched to a trouble spot or disaster area. Once on site, this flying ground station will not only become the hub of a local communications network, but will connect into the global system as well.

I could not cover every aspect of AFCS at one time. Out of the facts and figures I *have* used, I hope that these impressions concerning AFCS will remain.

AFCS—with headquarters at Scott Air Force Base—will soon be operating the world's largest single communications complex.

The scope of AFCS communications responsibilities is presently world-wide—because the Air Force it supports today operates globally.

Tomorrow—with the expanding development of our Aerospace Forces, we expect to operate communications and navigational systems in support of these forces.

AFCS was brought into being only after years of study, and only because it could improve the over-all operataional capability of the Air Force. As General Curtis E. LeMay, our Chief of Staff, also said on the day of AFCS's activation: "The organization of AFCS is in keeping with the express desires of the President for improved means of effecting command and control of our global forces."

". . . AFCS," General LeMay concluded, ". . . provides the Air Force with the reins of command."

Status of Thermionic Converters
(Continued from page 51)

Still another possible use for these thermionic generators is in a universal protective clothing system being developed by the U.S. Army Quartermaster Corps. These suits would have a heating and ventilating system to protect the wearer in a wide range of temperatures, and could be powered by a thermionic converter generator. Developmental work has begun on a complete thermionic power system for this purpose which would weigh about 8 pounds. These thermionic converters, incidentally, would be coated with or made of a special ceramic similar to that used on spark plugs in internal combustion engines. The ceramic coating is used to resist oxidation at temperatures above 1,000 degrees C.

The ability of thermionic converters to operate from a variety of fuels, including nuclear, provides attractive possibilities in the atomic energy field.

One special project, called STAR (for Space Thermionic Auxiliary Reactor), has been organized by General Electric to design a lightweight, nuclear power plant using thermionic converters for space vehicles and satellites.

Such nuclear plants would have thermionic converters imbedded in the walls of the nuclear device. Estimates of power outputs from these nuclear plants are in the range of a few kilowatts up to several megawatts.

Also under development is a vapor diode converter for use in nuclear power stations. This converter has a uranium-bearing cathode. The fissioning of the uranium in the cathode provides the necessary temperatures for conversion of heat to electricity. It is hoped that using such thermionic converters will permit a sizable increase in the electrical output of nuclear power plants at slight additional cost.

The money that has been spent in research and development efforts on thermionic converters has yielded beneficial results, and promising capabilities have been shown for many applications.

Future months will see an increasing amount of work by military and industrial groups in the advanced development and design engineering of thermionic converters for specific applications, speeding the realization of thermionic converters as practical, lightweight sources of electrical energy.

TRENDS IN WEAPONS SYSTEMS DEVELOPMENT

by JOHN H. RUBEL
Deputy Director, Research & Engineering
Office of Secretary of Defense

THE UNITED STATES HAS passed through a long era, of which the police action in Korea marked the last example, during which most of the development and virtually all of the procurement for our military forces took place only after active hostilities had commenced.

The end of World War II saw the signs marking the end of that era. Preparation after the fact had become a luxury we could no longer afford. There are a number of reasons why this has become true.

One is the pace of aerospace—atomic warfare. As soon as it became possible for intercontinental bombers to deliver dozens or hundreds of nuclear weapons, in a matter of hours, from a no-warning situation, it became obvious that we would have to be able to fight a war with forces in being whenever we might be attacked.

Another reason is the unprecedented threat of international Communism and the cold war that resulted when we faced up to the implacable intent of world domination and sought to resist it, in our role of leader of the free world.

Still another reason has been the altogether awe inspiring advances, not only in the frontiers of technology, but also in the rate of advance of those frontiers. The incentives for and the possibilities of harnessing technology to the problems of national defense are both at an all time high. Moreover, in the context of the cold war there is a new impact that technology has on national defense or national interest. Not only does technology provide the base for the weapon systems we must have against the eventuality of shooting wars, but it also is the yardstick by which an extremely important prestige contest is measured.

I have touched on some of the underlying factors which have made of Defense R&D the enormous undertaking that it is. The factors thus far covered have been largely in the nature of irresistible forces which shaped Defense R&D more or less beyond our control. There have however been other forces at work that were not of this character, not new found laws of nature. In any undertaking so large, and carried on in such an atmosphere of urgency, it was inevitable that there be lessons of a management type that we should have to learn through experience. At times this experience has been painful. At times it has been costly. This experience has taught us changes which we are making and will have to make in the way we conduct Defense R&D. I will want to say a bit more about these changes in work and to come, and about the circumstances which have brought them about, but first let me describe just what the Defense R&D effort is and promises to become.

For the past few years the annual Defense R&D program has hovered around $6 billion, equal to the entire Federal budget of 1931 or 1932. That represents the annual labor of about a million working men and women. Even more striking than its level of today has been its rate of growth. Since the establishment of the Department of Defense in 1947, in a decade the total defense research, development, test and evaluation effort has multiplied by a factor of twelve, from $500 million to the present level of about $6 billion. Many of the pressures that have brought about these changes are still at work.

We have undertaken in the last decade or so a number of very large so-called crash programs. In these we have accepted a certain amount of duplication of effort and even what superficially appeared to be wasteful effort. These prices we have willingly paid in return for the very material benefits of concurrency, that is, the ability to deploy a complex operational system in minimum time. This has provided us with urgently required levels of national defense that, given the history with which we lived, could not have been had any other way. These programs represent prideful accomplishment and in some instances, such as Thor and Polaris, almost unbelievable time scales from the freezing of concept to operational deployment. It is worth noting, however, and our ICBM programs are a case in this point, that had we somehow been wise enough to see the real requirement and the orderly way to achieve it on a more timely basis, we could have had the deployed systems we needed when we needed them with less frantic and quite possibly less expensive effort.

Perhaps more important, by and large, have been the development efforts on lesser systems and components. A number of factors such as administrative complexities, planning that was either not projected far enough ahead or failed to embrace enough considerations, and the like, have had the result that many developments simply never reached the stage of effective deployment in the field in the hands of troops. We all know of instances where weapons systems, or parts of them, after development proved to be too complex for effective troop use, too difficult to maintain, or incompatible with the real military environment that prevailed by the time they were available. I will touch, not necessarily in order of importance, on some of the things that have allowed this sort of mal-development to occur.

First, within the DOD our advance planning and requirement validation has sometimes been weak, with the result that we have developed some things for which there proved to be no real and sensible need.

Second, we have conducted too many individual efforts rather in a vacuum, with insufficient regard for parallel and competitive developments and for the decision points that should have resulted in some

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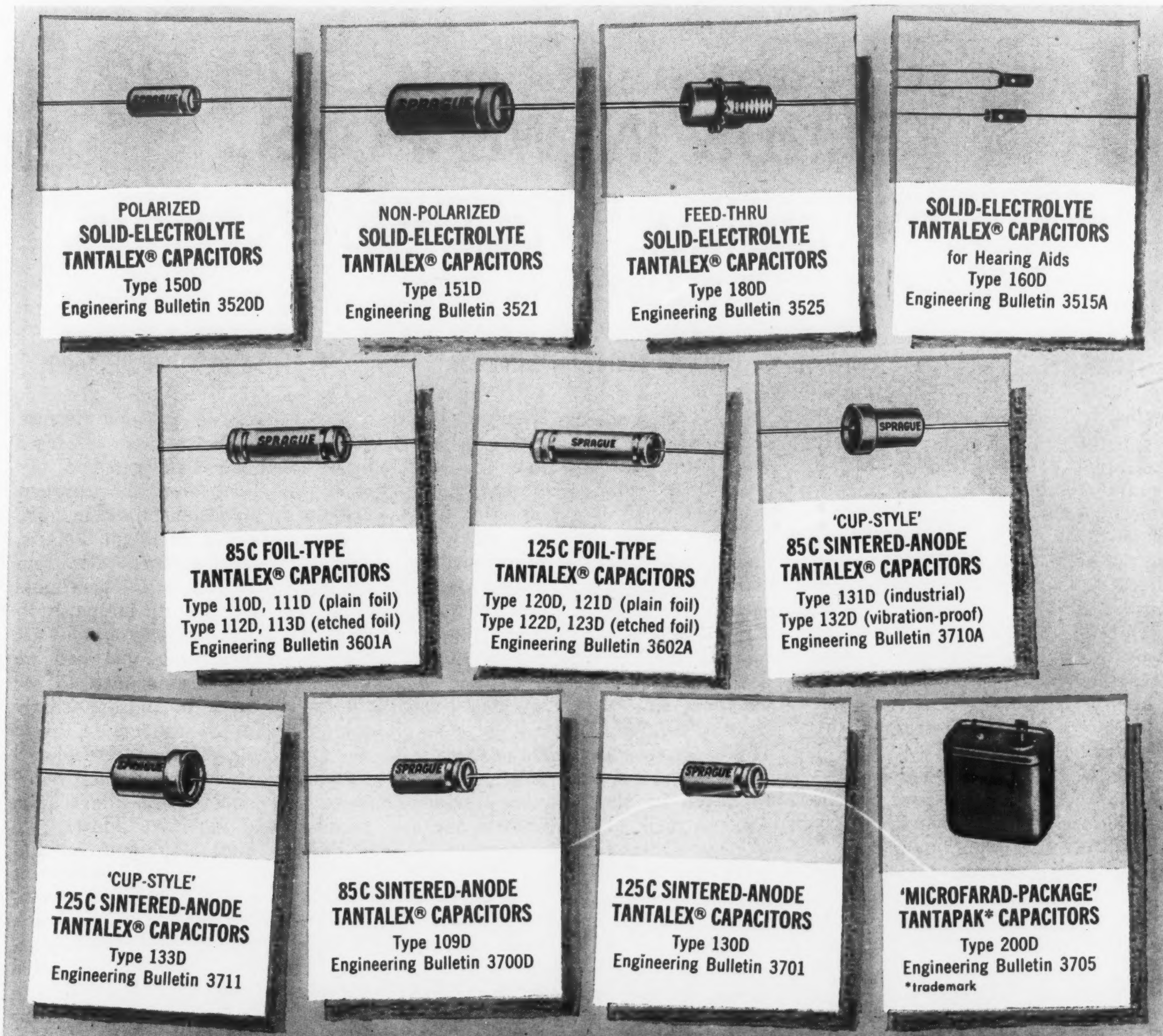

POLARIZED
SOLID-ELECTROLYTE
TANTALEX® CAPACITORS
Type 150D
Engineering Bulletin 3520D
NON-POLARIZED
SOLID-ELECTROLYTE
TANTALEX® CAPACITORS
Type 151D
Engineering Bulletin 3521
FEED-THRU
SOLID-ELECTROLYTE
TANTALEX® CAPACITORS
Type 180D
Engineering Bulletin 3525
SOLID-ELECTROLYTE
TANTALEX® CAPACITORS
for Hearing Aids
Type 160D
Engineering Bulletin 3515A
85C FOIL-TYPE
TANTALEX® CAPACITORS
Type 110D, 111D (plain foil)
Type 112D, 113D (etched foil)
Engineering Bulletin 3601A
125C FOIL-TYPE
TANTALEX® CAPACITORS
Type 120D, 121D (plain foil)
Type 122D, 123D (etched foil)
Engineering Bulletin 3602A
'CUP-STYLE'
85C SINTERED-ANODE
TANTALEX® CAPACITORS
Type 131D (industrial)
Type 132D (vibration-proof)
Engineering Bulletin 3710A
'CUP-STYLE'
125C SINTERED-ANODE
TANTALEX® CAPACITORS
Type 133D
Engineering Bulletin 3711
85C SINTERED-ANODE
TANTALEX® CAPACITORS
Type 109D
Engineering Bulletin 3700D
125C SINTERED-ANODE
TANTALEX® CAPACITORS
Type 130D
Engineering Bulletin 3701
'MICROFARAD-PACKAGE'
TANTAPAK* CAPACITORS
Type 200D
Engineering Bulletin 3705
*trademark

timely cancellations or redirections.

Next, we have suffered from what may be termed "tailfinism" in some of our designs. In part because of overstated requirements and in part because of engineering enthusiasms, there have been instances where system design was complicated with degrees of automation or miniaturization considerably beyond the point of diminishing returns in operational effectiveness.

Again we have sometimes failed to apply sufficiently high engineering standards to the mundane components of systems which were not edging the frontiers of state-of-the-art, perhaps because these mundane elements simply weren't as interesting or as challenging. At any rate, there has been a disappointing number of instances where a great, big, expensive failure would occur because of the malfunction of some such simple mechanism as a valve or relay.

Allied to all of the foregoing in our difficulties has been an increasing measure of built-in obsolescence. With some notable exceptions, and again I cite Thor and Polaris, our lead times from concept to deployment have tended to increase steadily. At the same time, technological possibilities have steadily advanced at a greater rate than past possibilities have been translated into operational hardware. Carried to a logical, if intolerable, conclusion, this could soon lead to a state of affairs wherein anything under active development was, by definition, obsolescent or obsolete.

There are other plagues of this sort one could list but I believe I have at least touched upon all of the major ones. The solutions to these problems are in no case simple, but in every case the solutions are suggested by the very statements of the problem. In summary, and with the obvious risk of oversimplification, let me observe that the solutions lie within the following things which we must do:

- Our advanced weapon planning within DOD must assume a more forward-looking and better integrated character. There has been real progress in this and there are many promising trends in train.
- Specifically, there must be more unity in our research and development planning and in the management of all aspects of research and development effort from basic research on through hardware procurement. I believe the steady evolution of the Office of the Director of Defense Research & Engineering and all the relationships of that office with the R&D communities of the Services reflect a hopeful and necessary trend in this direction.
- We must redevelop our team efforts between DOD management and Industry to insure on the one hand that we are developing something we really need, and something that is really technologically attainable on the other hand.
- We must avoid becoming so preoccupied with the exotic features of complex systems that we overlook the abiding requirement for high grade engineering effort in the most lowly parts of every system.
- Finally, we must wage an unrelenting fight against the tendency for lead times to stretch out in any of the many ways that this can happen, and project our development goals such that our deployed systems can enjoy a reasonably long and useful life.

Space Communications and Iron Curtain Countries

(Continued from page 39)

the use of satellites for commercial purposes and as public information media.

The commercial use of communications satellites has become almost a necessity to handle the 700 per cent increase in trans-oceanic communications anticipated during the present decade. Even the new transistorized cable planned for about 1970 will be outdated by 1965, five years before it is to start operation. Space telecommunications have become an integral element of the world's increasingly internationalized economy.

Of perhaps equal importance is the function of space communications in the current battle throughout the world for the minds of men. The impact of communications on undeveloped peoples has changed the political map of the world during the past generation, and, with the spread of modern communication facilities by means of satellite relays to all parts of the world, the impact of communications may be even more radical in the future.

As a critical consideration in the formulation of our nation's foreign policy, the importance of space telecommunications can hardly be overemphasized.

Scarcity of Frequencies

Despite the obvious importance of space communications, efforts to secure international protection for space communications have by no means been successful.

The principal reason is the fact that radio frequencies are a scarce resource. Although in theory the number of radio frequencies is without limit, in actuality the number of frequencies available for space communications is restricted to only a small percentage of those needed to effectively utilize the potentialities of space communications.

Almost the entire frequency spectrum is already allocated to other non-space uses, and the problems of reallocation, including the cost of replacing equipment designed for specific frequencies, makes provision for the needs of space communications a highly contentious matter. The problem of reserving frequencies for space communications is complicated by the necessity of attaining complete, or nearly complete, elimination of man-made interference, particularly for radio astronomy and for delicate telemetering requirements. Furthermore the Doppler effect makes it necessary to reserve bands for space communications considerably wider than would be necessary for the normal earth transmitter. Extra width for space communication bands is also required by the increasingly complicated messages, such as weather photos, which are being used in space communications, and by the use of frequency modulation for better reception. Of greatest importance is the fact that for technical reasons many of the unsaturated frequencies are not suitable for space communications.

The principal technical factor controlling the allocation of frequencies for space use is the difficulty or unreliability with which certain frequencies propagate through the ionosphere or, above 10,000 megacycles, even through raindrops or water-vapor. Other important factors are the decreasing directivity of signal possible and the decreasing effectiveness of the small or compact antennas in space vehicles as the frequency is reduced, the erratic effect on certain frequencies of the upper atmosphere, and the variability from one frequency to another of interference, including background interference not caused by man.

The problem of frequency suitability is particularly acute in the field of radio astronomy, where reception of emissions from certain elements in space, specifically, deuterium, hydrogen, and OH, does not allow any choice among frequencies. If the signals are to be received at all they must be received on the specific frequencies of each element.

As a consequence of the limited spectrum suitable for space communications and of the occupation of much of this spectrum by other users, international agreement must be reached to reserve certain frequencies for space use. Subsidiary problems calling for international agreement are the registration, identification and automatic cutoff of satellite transmitters.

In addition, international machinery must be improved to establish an orderly process of review so that the spectrum crowding can be alleviated by the application of new technical developments. New techniques are constantly being developed to open other portions of the spectrum, to better control the quality of emissions in order to reduce the size of the necessary guard bands between operating frequencies, to decrease band width requirements, and to decrease background noise inherent in receiver components in order to increase the signal-to-noise ratio. Without effective international organization, however, the utilization of the new techniques in spectrum allocation may suffer from a time lag of several years.

The foregoing has briefly outlined the need for international cooperation in space telecommunications.

(End of Part I. Part II will appear next month.)

COMMUNICATIONS —A LOOK AHEAD

by
BRIG. GEN. DAVID SARNOFF, USAR
Chairman of the Board
Radio Corporation of America

THERE WERE a number of significant communications "firsts" registered by the United States a century ago. We were the first nation to use telegraphy extensively for military purposes. It may surprise you, as it did me, to learn that Andrew Carnegie of steel and library fame is considered the father of military telegraphy. It was he who set up the elaborate system of wires behind the Union Armies.

The Civil War marked the first time that military signals could transcend the line-of-sight and pierce the fire and fog of battle. Telegraphy made Abraham Lincoln the first American President able to function as Commander-in-Chief of the Armed Forces in the modern control sense. It also spurred the growth of a great institution, the United States Army Signal Corps, of which I am proud to be a member. Telegraphy demonstrated how a civilian invention could find a useful military application, and it marked a significant step across the formidable communication barriers of time and distance.

Challenge of Communications

The historic progress of communications across these barriers parallels man's advance on this planet. The first communications were sight and sound, man-to-man, over distances of only a few feet. Since then, our primary effort has been to extend that distance. We will achieve the earth-bound ultimate when we have direct man-to-man communications, both sight and sound, to any place on earth, regardless of distance. We will achieve the universal ultimate when we have man—and possibly other species of life—exchanging communications over distances of millions of miles.

In its own way, every communications advance has moved us nearer these ultimates. The Greek, Roman and Aztec relay runners contributed to the stretch-out; and so did the shouting sentinels on Caesar's battle towers, the homing pigeons used at Waterloo, the primitive semaphore employed by George Washington who placed a barrel, a flag and a basket on a mast and then issued orders to his troops by altering their relative positions.

In the present century, the great stretch has come through applications of radio communication. In its *first phase,* radio enabled communication between a fixed point on land and ships at sea and between ships themselves, or between two land areas across the ocean barriers. Today, radio is employed by all types of moving vehicles and between fixed stations and relay points on land. The *second phase* brought the human voice and instrumental music to millions of listeners through radio broadcasting. The *third phase* brought the stretch-out of sight, first through black-and-white television and now through color.

Vast progress has been made in the art of communications but there are many more promising prospects ahead. The sound of the human voice can be projected directly and almost instantaneously to any area of the world. We have extended sight, by television, so that the people of a nation, or a group of nations on the same continent, can see the same picture simultaneously. We are on the threshold of projecting that picture between continents. In fact, we are very close to the achievement of global television as well as other forms of world-wide communications.

This will represent *phase four* of the radio communications story. I believe it will be realized in this decade through the use of relay satellites orbited in space. The challenges facing us in this area are no longer how; rather they are when, what types of hardware, what form of control, what character of international traffic?

Fundamentals of Satellite Communications

Because of the complex and varied nature of the problems involved in satellite communications, there has been considerable confusion about the subject. It is well to bear in mind certain fundamentals.

First, satellites will expand, broaden and speed the services we have today and make them available to places and peoples that do not have them now. In the transmission of intelligence, a communications satellite is basically a distance booster. It is as if we picked up a microwave tower from the ground and hung it in the sky. This would increase enormously the range over which communications could be sent and received.

Second, satellites will not make

". . . exploration on the surface of the moon would establish the practicability of installing there the first interplanetary radio relay station. . ."

anyone a Croesus overnight. I have heard suggestions that once a satellite system is in operation, international communications will become a one-hundred-billion-dollar-a-year business. To people whose estimates run along these lines, I would reiterate Andrew Jackson's famous order at the Battle of New Orleans: "Elevate them guns a little lower!"

The international communications business of all the American carriers today amounts to about one hundred-and-thirty-five-million-dollars-a-year. In the Seventies, with a satellite system in use, operating revenues may reach the one billion-dollar-mark. This is a respectable amount but even if we double this figure, it would still be ninety-eight per cent less than the fantastic figure of one hundred-billion dollars-a-year.

Third, the much-debated question of satellite ownership is, in my opinion, far less important at this time than the adoption of the right system at the earliest possible moment. I believe that if we coordinate our knowledge and our skills, formulate a definite plan and concentrate on our objectives, we can be the first nation to establish and operate a global system of satellite communications. This would be a dramatic advance in the use of outer space for peaceful purposes. It would benefit all mankind and give an effective demonstration of American initiative, vigor and leadership.

In analyzing this subject, it seems to me that certain basic principles should be recognized.

Regardless of who, or how many, may own the satellites, there should be direct access to them by all present and future organizations licensed by our Government to operate in the field of international communications.

The satellites should be available to all such organizations on reasonable and non-discriminatory terms for any services which the Federal Communications Commission authorizes them to provide now or in the future. No restrictions should be imposed against such use, through contract or otherwise, by anyone who may own, control or operate the satellites.

Each licensed American organization should have the right to establish, own and operate its ground stations for transmitting and receiving signals via the satellites. The system, itself, should be designed to provide this capability.

My organization, of course, is deeply involved in this satellite development. We have proposed a concept of large capacity, synchronous—or stationary—satellites, positioned at two or three locations about 22,000 miles above the equator. Our scientists have developed specifications for the system which are within the present state of the electronics art. I believe our concept is capable of achievement in time to meet the communications demands that will overburden international submarine cable and radio circuit facilities later in the Sixties.

As you know, other companies and agencies have come forward with other satellite concepts. Intensive research is now in progress in the Defense Department, in the National Aeronautics and Space Administration, and in private industry. As one example, my company is developing under contract from NASA, an experimental satellite for Project Relay which we hope will provide many of the answers we all seek.

To expedite the achievements possible in this area, we at RCA feel the time is ripe for the formation of a joint government-industry group to pursue an aggressive total effort in research and development. Through this collaborative effort, we can agree on the best satellite communications system. We can get it in operational orbit in the shortest time, and we can share with the world a remarkable technique for nation-to-nation seeing and talking.

It is most encouraging that the urgent character of this project is recognized at the highest level of our government. Last June, for example, according to press reports, President Kennedy ordered a top-level policy study into how a communications satellite system can be brought into operation at the earliest practicable moment.

Recently, I suggested that the United Nations be given programming access to the first satellite television channel, so that it might project to the whole world a live picture of crucial deliberations in the Security Council and General Assembly. The favorable response to this proposal from many leaders of the Open World encourages me to urge it again.

Direct access to vital United Nations debates, it seems to me, should go a long way toward awakening those in the closed world of Communism who have rarely been exposed to the free clash of ideas in any forum. The Communists can be expected to jam and black out these programs. But such conspicuous exclusion from proceedings open to the rest of mankind will generate pressures from their subjects which the Communist rulers will find it ever harder to ignore. At the least, it would dramatize an essential difference between free and enslaved societies.

As for the developing and neutralist nations, if, as we believe, the United Nations represents their best hope for establishing and maintaining their own independence, then their understanding of its aims—seen with the same impartial picture in Asia and Africa as in Europe and America—must be the best hope of the U. N. for assisting them effectively.

Communications and Space Exploration

As we progress with the satellite project, I believe we will also move ahead with phases five and six of our communications blueprint. *Phase five* will be directed to communications with the moon and beyond. Here, we will be concerned initially with communications as a control and intelligence mechanism. This function will be crucial to the successful placing of men on the moon and, ultimately, on distant planets.

(*Continued on page* 66)

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The proposed manned moon shot, which President Kennedy set as a national goal, has prompted the scientists of RCA's Astro-Electronics Division, along with others, to develop comprehensive exploratory plans. Our concept envisages the establishment of a well-stocked camp on the moon before the first man arrives there. The moon camp would include food, water, power, laboratory equipment, an exploration vehicle, appropriate emergency survival tools and a re-entry capsule for the manned return trip to the earth.

A combination of a Saturn rocket and ground control devices should make it possible to put on the moon's surface a roving vehicle and to conduct a survey for the most appropriate area for a manned landing. This would be based on such factors as terrain, illumination, temperature and other environmental characteristics. Then, through a series of subsequent Saturn shots, the camp could be established by sending up the necessary equipment and supplies, including a moon-crawling tractor for assembly purposes. This entire operation could be checked out by instrumentation controlled from the ground before we commit men to lunar flight.

The success of this plan would prepare the way for exploration of the nearest planets. It would establish a pattern for the construction of other advance bases. In addition, validation of the techniques for storing fuel and re-fueling vehicles on the moon would lay an effective foundation for use of the moon itself as a launching platform for spacecraft.

It is also conceivable that exploration on the surface of the moon would establish the practicability of installing there the first interplanetary radio relay station, controlled from the earth and capable of providing vital communications and navigational links for space vehicles as they move toward distant planets.

We face, of course, many unknowns—such as the nature of the lunar surface, the extent of radiation hazards from solar flares, and the effect of the lunar environment on materials. It can be generally stated, however, that the communications and controls problems in this concept fall within our present capabilities.

With our sound and sight satellites in orbit around the earth and with electronic channels opened to the planets, we will have extended enormously the communications stretch-out that started with the first man-to-man talk.

Our principal job in *phase six* of the communications blueprint will be to come full circle and permit direct man-to-man, sight-and-sound communications over the ultimate in distances.

The speed with which we accomplish this will depend, in part, upon the speed with which we can shrink electronic gear. This is another great challenge facing electronics today.

Through formidable advances in micro-modules, we are achieving new diminutives daily. We can now foresee a computer so compact that it will have a density equivalent to one hundred-million active elements per cubic foot—a density approaching the compactness of the human brain itself. And this computer, indeed, will perform many functions of the brain.

Conclusion

The price for achieving the communications advances I have outlined will come high—in dollars, in planning, and in work.

This country has the scientific manpower and know-how to meet and to surpass any challenge in this area. But something else must accompany it: a firm national resolve to do whatever must be done to assure our success. We must, for one thing, understand and properly evaluate the objctives of the potential enemy.

In communications, we possessed the initiative and the leadership in the days of Mr. Carnegie and we possess them today—from automation to satellites. Yet, this unbroken continuity should give us no cause for complacency. "The minute you get satisfied with what you've got," Boss Kettering once said, "the concrete has begun to set in your head." In terms of our nation's leadership posture before the world and our national policy of advancing the cause of peace everywhere, there is too much at stake here to permit any concrete to infiltrate our communications arteries.

It is my conviction that America can continue to lead in this vital field, that we can be the first to achieve practical world-wide satellite communications and that we can complete the cycle by which man will communicate with man, directly, wherever he may be. I also believe that by the time this is accomplished, it will be possible to achieve automatic translation of languages so that when we speak to each other we will *understand* each other. And that, after all, is the goal not only of our Science of Communications, but of humanity itself.

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Today's Challenging Requirements

(Continued from page 43)

Command and Control must deal with problems of all sizes. For 16 years we have undergone many different shapes and sizes of requirements. Communications has been the key to successful Command and Control all this while, and it has seldom been good enough.

Just as astute and successful diplomacy has historically obviated resort to arms, so small operations, undertaken in time, with full information, judgement, and precision, may well obviate resort to massive nuclear war. To engineer systems capable only of monolithic control and only of pin point centralization is to build with disastrous disregard of vulnerabilities. Concepts of Command and Control and the systems by which they are implemented must provide for deliberate response, and for either centralized or decentralized execution. Otherwise they have no resiliency. This is the accepted policy today.

In short, future developments in Command and Control must emphasize integration, survivability, sureness, flexibility—the capability for deliberate response, always under the control of constituted authority.

Finally, I have no reason to doubt the prophesy of the Electronic Industries Association that by 1970 the electronics industry of this country will be grossing $20 billion annually. In the case of the Military, communications-electronics has permeated our daily way of life to such an extent that practically anything we undertake depends upon it now, and will in the future.

How we use this $20 billion will not make a significant difference to the industry as a whole, but it can make all the difference to the strength of this Nation. The teamwork between the electronics industry, the scientists, the Military, and the other agencies of Government must be very close indeed. Everyone of influence and responsibility in these areas must think more and more in terms of the over-all national task of defense and the successful execution of our national purposes, never just in terms of specific hardware systems.

Simplicity as Well as Efficiency

It is my strong conviction that all of us are close partners in the National Defense. All of us are vitally concerned that the communications-electronics systems contributing to National decision-making, and through which the National Will is carried out, will do the job.

We all know, or can surmise, that the familiar unclassified requirements, such as those expressed today, are matched by the classified ones. We know that the systems we provide must meet every test of versatility, speed, security, and continuous availability; otherwise, they will tie up the National machinery. We must appreciate that the softwear, the brainwork, the think through, the re-think, the broad understanding of the National requirement is the real payoff area.

Emphasis on brain effort before hardware effort can show both excesses and deficiencies, neither of which can be tolerated; this brain effort must proceed from the experienced operators, the engineers, and the producers, as well as the scientific minds.

With warm consideration for the vital role of thousands of fine young fellows under 21 years of age who make up more than 50 per cent of our enlisted strength today and upon whose talents the successful use of these systems depends, I entreat all who create these systems to match them to the human product of the most intelligent Creator of all.

For over 50 years, AE has had a hand in the development of specialized communications systems for the armed forces.

This record of service is the result of AE's ability to translate its commercial experience into equipment designs to meet critical military requirements.

Cases in point are: The *Electronic Sentry** Automatic Warning Unit, designed to detect a wide range of hazardous conditions and alert personnel by telephone —the *Automatic Recorder-Announcer* that records a spoken warning from any one of a number of positions, and retransmits the warning over as many as 100 channels—and the *Municipal Emergency-Reporting System* that automatically reports emergencies and their locations by telephone, teletype and visual signal. All three are applicable to military installation requirements.

Automatic emergency signalling systems of this sort are a logical extension of AE's 70 years of experience in the design and manufacture of dial telephone equipment.

If you have a problem in communications or control, AE can help — with engineering aid, basic components or complete control systems. For quick results, write or phone (FIllmore 5-7111) the Manager, Government Service Division, Automatic Electric Sales Corporation, Northlake, Illinois.

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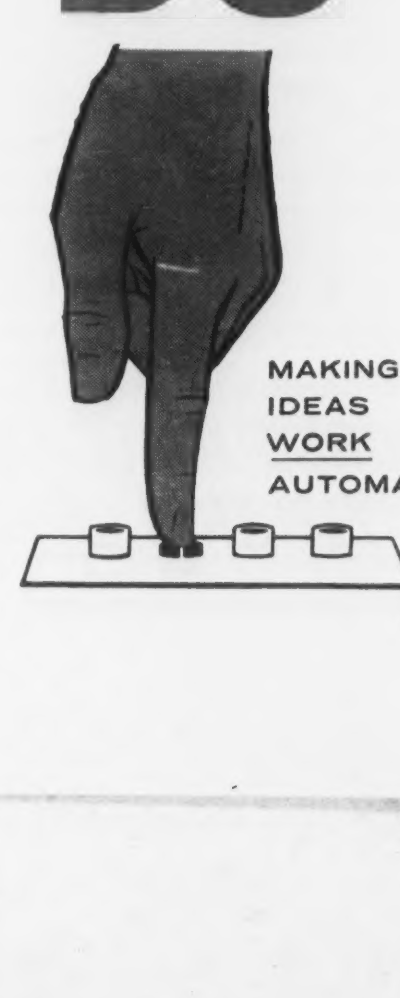

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AFCEA Convention

On April 28-29, 1947, the Army Signal Association climaxed its first year of existence by holding a banquet and convention at New York and Fort Monmouth, New Jersey. Over 700 members assembled to hear a discussion conducted by the Army Signal Corps and to view exhibits of electronics and photography equipment. The visitor at Fort Monmouth on April 29 knew that our Armed Forces were abreast of the field in electronics, communications and photography. Over the last decade and a half, AFCEA's Annual Convention has continued this service and provided thousands of Convention goers with information on topics and equipment of vital interest to communications and electronics people.

Next June 12, 13, 14, the 16th Annual AFCEA Convention, to be held at the Sheraton-Park and Shoreham Hotels in Washington, D. C., is expected to be attended by over 5000 men and women. Three panel discussions will be conducted by Litton Industries, Incorporated, American Telephone & Telegraph Company and The Western Union Telegraph Company. 250 exhibitors will display the latest developments in equipment. Four social events have been scheduled. In fifteen years' time the Annual Convention has expanded in size and scope but its purpose is the same—to provide a continual review and evaluation of the latest in communications and electronics; modern and future equipment; and fellowship for the civilian-military team members.

AFCEA Sustaining and Group Members

Communications—Electronics—Photography

Listed below are the firms who are sustaining and group members of the Armed Forces Communications and Electronics Association. By their membership they indicate their readiness for their share in industry's part in national security. Each firm nominates several of its key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in the electronics and photographic fields, available for advice and assistance to the armed services on research, development, manufacturing, procurement, and operation.

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ATLANTA: Pres. — Capt. I. J. Schwartz, USN, USN Air Station, Atlanta, Merritt, Ga. Sec.—M. S. Butler, P. O. Box 685, Atlanta Airport, Atlanta 20, Ga.

AUGUSTA-FORT GORDON: Pres. — Col. T. J. Trainor, Route 2, Box 1016, Augusta, Ga. Sec.—L/C H. T. Crowell, Hqs. Detachment (Television Branch) U. S. Army Southeastern Signal School, Ft. Gordon, Ga.

CAPE CANAVERAL: Pres.—G. Meredith, 110 Atlantic Blvd., Eau Gallie, Fla. Sec. —Lt. Col. L. A. Breece, 399 Norwood, Eau Gallie, Fla.

CENTRAL FLORIDA: Acting Sec.—R. R. Randell, 208 So. Manhattan Ave., Tampa, Fla.

GULF COAST: Pres.—H. D. Yund, 10 - 30th St., Gulfport, Miss. Sec.—R. C. Cox, Southern Bell, 500 Rich Ave., Gulfport, Miss.

LOUISIANA: Pres.—J. C. Morris, 206 Gibson Hall, Tulane U., 6823 St. Charles Ave., New Orleans 18. Sec.—R. C. Hingle, Southern Bell Tel. & Tel. Co., 1215 Prytania St., New Orleans, Louisiana.

MIDDLE GEORGIA: Pres. — John Booth, Southern Bell Tel. & Tel. Co., 787 Cherry St., Macon, Ga. Sec.-Treas.—J. D. Walker, Southern Bell Tel. & Tel. Co., Warner Robins, Ga.

MONTGOMERY: Pres.—Lt. Col. Herbert Herman, Air Command & Staff College, Maxwell AFB, Ala. Sec.—Luther L. Hall, 3549 Cloverdale Rd., Montgomery, Ala.

NORTH CAROLINA: Pres.—Col. P. Van Sloun, XVIII Airborne Corps, Ft. Bragg, N. C. Sec.—H. N. Simpson, Carolina Tel. & Tel. Co., Tarboro, N. C.

NORTHWEST FLORIDA: Pres.—Col. S. K. Briggs, 708 Osegola Cir., Eglin AFB, Fla. Sec.—Maj. N. E. Zielinski, Hq. APGC, Elgin AFB, Fla. Sec.—W. E. Shine, 505 Gaffney Rd., Eglin AFB, Fla.

ORANGE: Acting Pres. — Vincent Meder, 744 S. Hampton, Orlando, Fla.

PENSACOLA: Pres.—Lt. Cmdr. H. M. Young, 4216 Acacia Dr., Pensacola, Fla. Sec.—D. E. Hansen, 208 Emerald Ave., Pensacola.

REDSTONE-TENNESSEE VALLEY: Pres.—Col. Earl J. Dotson, Sig. Office Hq. USA Ordnance Missile Command, Redstone Arsenal, Ala. Sec.—Lt. Col. Henry B. Holmes, III, AOMC Sig. Office, Redstone Arsenal, Ala.

SOUTH CAROLINA: Pres.—H. L. Lackey, Southern Bell Tel. & Tel. Co., Columbia, S. C. Sec.—K. Hora, Southern Bell T&T Co., Owen Bldg., Columbia, S. C.

REGION D

Regional Vice President—Maj. Gen. Harry Reichelderfer, USA (Ret.), Southwest Research Institute, 8500 Culebra Rd., San Antonio, Tex. ***New Mexico, Texas, Oklahoma, Arkansas.***

LAWTON-FORT SILL: Pres.—Lt. Col. L. W. Ash, 1303 W. Upton Rd., Fort Sill, Okla. Sec.—Lynn Russell, 1805 Dearborn, Lawton, Okla.

NORTH TEXAS: Pres.—R. T. Shiels, Anaconda Wire & Cable Co., 1201 Fidelity Union Life Bldg., Dallas 1. Sec.—Robert J. Novak, AT&T Co., 212 No. St. Paul St., Dallas.

SOUTH TEXAS: Pres.—Col. A. Burke, Hqs., 4th U. S. Army, Ft. Sam Houston, Texas. Sec.—W. Gillum, (same address).

TINKER-OKLAHOMA CITY: Pres.—W. J. Cook, P. O. Box 5766, Midwest City, Okla. Sec.—R. E. Davis.

WHITE SANDS MISSILE RANGE: Pres.—S. D. Cozby, 704 Sugeant St., White Sands, N. M. Sec.—C. E. O'Meara, 1400 S. Luna, Las Cruces, N. M.

REGION E

Regional Vice President—Walter H. Pagenkopf, Teletype Corp., 5555 Touhy Ave., Skokie, Ill. ***Michigan, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri, Kansas, Nebraska, North Dakota, South Dakota, Wyoming, Colorado.***

CHICAGO: Pres.—Walter H. Flinn, Illinois Bell Tel. Co., 212 W. Washington St., Rm. 1601, Chicago 6, Ill. Sec.—Sanford Levey, 1303 Lincoln Ave. So., Highland Park, Ill.

DECATUR: Pres.—Capt. J. J. Lacey, 53 Whippoorwill Dr., Decatur, Ill. Sec.—H. E. Malone, 3814 Arthur Ct., Decatur, Ill.

GREATER DETROIT: Pres.—Col. J. I. Vanderhoof, 1921 Brock Court, Ann Arbor, Mich. Sec.—J. R. Saxton, Michigan Bell Telephone Co., 1109 Washington Blvd. Bldg., Detroit.

KANSAS CITY: Pres.—Lt. Col. H. Young, Jr., 29th AD Hq., Richards-Gebaur AFB, Mo. Sec.—W. B. Foulis, Jr., AT&T Co., Rm. 870, 811 Main St., Kansas City, Mo.

ROCKY MOUNTAIN: Pres.—W. R. Young, Asst. Govt. Mgr., AT&T Co., Tejon & Pikes Peak Ave., Colorado Springs, Colo. Sec. —A. D. Miller, Mt. States Tel. & Tel Co., 2542 E. Bijou, Colorado Sprgs., Colo.

SCOTT-ST. LOUIS: Pres.—Col. C. W. Evans, USA (Ret.), Southwestern Bell Telephone Co., 1010 Pine St., Rm. 827, St. Louis 1, Mo. Sec.—A. L. Eisenmayer, P.O. Box 456, Trenton, Ill.

REGION F

Regional Vice President — Lt. Cdr. Ray E. Meyers, USN (Ret.), Consultant, 717 Anderson Way, San Gabriel, Calif. ***Arizona, Utah, Nevada, California, Idaho, Oregon, Montana and Washington.***

ARIZONA: Pres.—Lt. Col. James W. Tuma, 109 Madden, Fort Huachuca, Ariz. Sec.—Frank T. Trippi, Hqs. USA Electronic Proving Ground, P.O. Box 436, Fort Huachuca, Ariz.

GREATER LOS ANGELES: Pres.—John W. Atwood, Hughes Aircraft Co., Culver City Calif. Sec.—Joseph H. Goodrich, Pacific Tel. & Tel. Co., 737 S. Flower St., Los Angeles 17, Calif.

SACRAMENTO: Pres.—R. C. Berner, Pacific Tel. & Tel. Co., 4501 Arden Way, Sacramento 25, Calif. Sec.—Miss Ethel Klusman, 4925 Marconi Ave., Carmichael, Calif.

SAN DIEGO: Pres. — Capt. B. L. Bailey, USN, Cmd. Off. Miramar Naval Air Station, Miramar 45, Calif. Sec.—J. C. Orthel, 5483 Redding Rd., San Diego 15, Calif.

SAN FRANCISCO: Pres.—Col. H. L. Davis, Jr., 331 Infantry Terrace, Presidio of San Francisco, Calif. Sec.—H. W. Weddell, Rm. 117, Bldg. 35, Presidio of San Francisco, Calif.

SANTA BARBARA: Pres.—RAdm. Clarence C. Ray, 63 Manzanita Lane, Star Route, Santa Barbara, Cal. Acting Sec.—E. E. Foley, P.O. Box 636, Santa Barbara, Calif.

SEATTLE: Pres.—RAdm. H. H. McCarley, USN, 436 168th St., S.E., Bellevue, Wash. Sec.—Cdr. W. L. Bushy, USN, Hqs. U. S. European Cmd., APO 128, N. Y., N. Y.

EUROPEAN REGION

Regional Vice President—Brig. Gen. Kenneth F. Zitzman, USA (Ret.), International Standard Engineering, Inc., 40 Rue de Sevres Boulogne Billancourt Seine, France.

FRANKFURT: Acting Pres.—Ralph L. Prokop, USA Procurement Center, APO 757, N. Y.

LONDON: Pres.—Lt. Col. S. B. Hunt, USMC, Cincnelm, Box 91, FPO, N. Y., N. Y. Sec.—Lt. Col. J. C. Posey, HQ. 3d COMM. GP., APO 125, N. Y., N. Y.

PARIS: Pres.—RAdm. T. A. Torgerson, HQ. U.S. EUCOM C E, APO 123, N. Y., N. Y. Sec.—Cdr. W. L. Bushy, USN, Hqs. U.S. European Cmd., APO 128, N. Y., N. Y.

SWITZERLAND: Pres.—B. R. Dean, 13 Quai de L'ile, c/o RCA, Geneva, Sec.—Lt. Col. A. David, Royal Signal, British Army, U. N., Geneva.

PACIFIC REGION

Regional Vice President—Brig. Gen. Douglas Williams, USAF, Staff CINCPAC, APO 953, San Francisco, Calif.

HAWAII: Pres.—Col. W. A. Simpson, USA Signal Office, Hq. USARPAC, APO 958 San Francisco, Calif. Sec.—Lt. Col. G. A. Kurkjian, USA (same address).

MARIANAS: Pres.—Capt. C. J. Alley, USN, U. S. Naval Comm. Sta., Navy 926, FPO, San Francisco, Calif. Sec.—Lt. Cmdr. W. Scott, USN, P. O. Box, FPO, San Francisco, Calif.

OKINAWA: Pres.—Lt. Col. L. P. Wynne, Cmdr. 1962nd AACS Squadron, APO 239, San Francisco. Sec.—E. N. Dotson, USCAR, APO 331, San Francisco.

PHILIPPINE: Pres.—Lt. Col. A. W. Hall, STARCOM, QTRS. 31 Clark, U. S. Acan Station, Philippines, APO 74, San Francisco, Calif. Sec.—J. C. Behrick (same address).

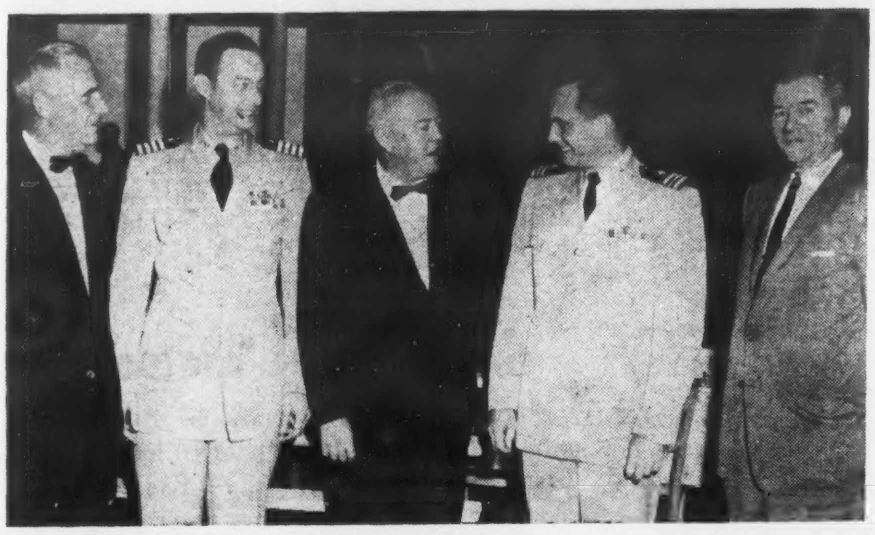
TOKYO: Pres.—Capt. W. H. Kreamer, USN, Staff COMNAVFOR, Japan, FPO, San Francisco, Calif. Sec.—Lt. W. E. Trelford, USN (same address).

CHAPTERS AT LARGE

ALASKA: Pres.—Col. H. L. Hughes, USAF, Hq. Alaskan Communications Region, APO 942, Seattle, Wash. Sec.—T. C. Harris, 2411 Karluk St., Anchorage, Alaska.

SAN JUAN: Pres.—W. Siddall, Radio Corporation of Puerto Rico, P. O. Box 3746, San Juan 18, P. R. Sec.—A. R. Crumley, Jr., Crumley Radio Corp., Box 10073, Caparra Heights, San Juan.

Chapter News



Fort Monmouth—(Photo left) Pictured at a recent chapter meeting are (L. to R.) Gen. Wm. D. Hamlin, Fort Monmouth Commander; Capt. S. E. Edelstein USN, director of Armed Services Electro-Standards Agency; Col. Murray A. Little, chapter president; Cdr. J. H. Nicholson USN, and Dr. H. K. Ziegler, chief scientist, U. S. Army Signal Research and Development Laboratory. **New York**—(Photo right) Shown at a chapter meeting are (L. to R.) Gen. Sandretto, USA (Ret.); Col. H. B. Evans, USA (Ret.); Adm. H. J. Goldberg, vice chief Naval Materials; Maj. Gen. D. P. Graul, Deputy Commander, AFCS; Glenn Montgomery, chapter president, and Frank Gunther, national president, AFCEA.

REGION A

Fort Monmouth

The first monthly dinner-meeting of the new season was held September 21 at Gibbs Hall Officers Club, Fort Monmouth.

Lieutenant Commander John H. Nicholson, USN was guest speaker. Commander Nicholson spoke on the Navy's nuclear submarine, SARGO. His talk was illustrated with slides of SARGO'S cruise under an Arctic ice pack.

The next chapter meeting was held October 19. Dr. Constintine B. J. Generales, director, Space Medicine Research was guest speaker.

New York

A dinner meeting was held September 27 at the Belmont Plaza Hotel, New York City. Major General Donald P. Graul, Deputy Commander, Air Force Communications Service (AFCS), was guest speaker.

In his speech, "Air Force Communications Service," General Graul described the scope, functions, and organization of the AFCS.

REGION C

Cape Canaveral

Don Giles of the Martin Company of Orlando, Florida was guest speaker at the luncheon meeting held September 21 in the Missile Room of the Patrick Air Force Base Officers Club.

Mr. Giles presented an illustrated lecture on Random Access Correlated Extended Performance (RACEP), a new method of multiplexing numerous channels of intelligence on a 4 mc wide radio channel.

G. Denton Clark, Supervisor of the Radio Corporation of America Missile Test Project for Cape Canaveral was a guest of honor.

Gulf Coast

Robert Elliot of Southern Bell Telephone Company was guest speaker at a dinner meeting held September 11.

Francis Lundy, district manager, Southern Bell Telephone Company, introduced Mr. Elliot. Mr. Elliot presented the Optical Maser demonstration which was featured at the 15th National AFCEA Convention.

Over 200 members attended the meeting. About thirty high school science teachers and students were also present.

REGION D

South Texas

R. W. Henderson, vice president, weapons program, Sandia Corporation, was guest speaker at the September 21 dinner meeting held at the Randolph Air Force Base Officers Club. Mr. Henderson spoke on the future of Nuclear Materials.

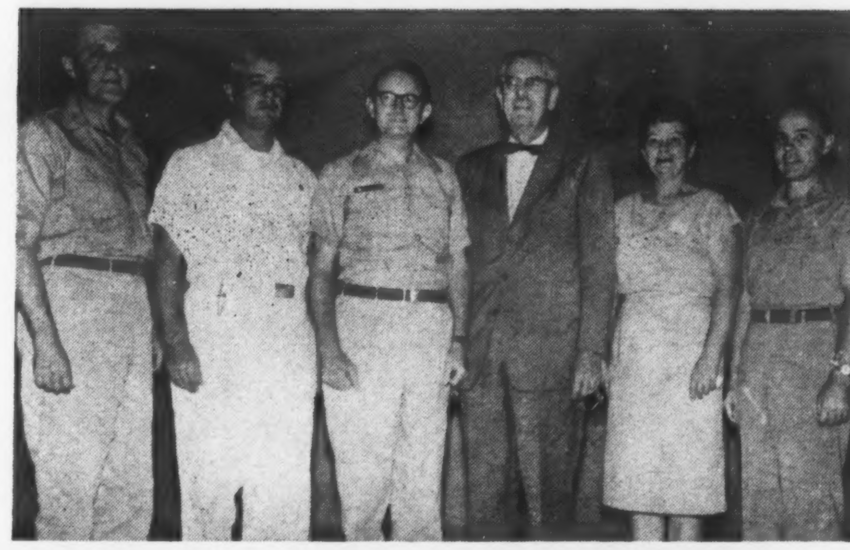
In his speech, Mr. Henderson covered such topics as the nuclear weapons program, possible uses of nuclear explosives for peaceful purposes, nuclear reactors for power generation, nuclear propulsion, and nuclear auxiliary power supplies for space vehicles.

REGION E

Scott-St. Louis

Major General Harold W. Grant, Commander, Air Force Communications Service, was guest speaker at the September 8 dinner meeting. General

Gulf Coast—(Photo left) Shown at a recent meeting are (L. to R.) A. Y. Donaldson, science teacher, West Junior High School, Gulfport; D. Horne, and L. Packard, high school students; as Robert Elliot, vice president marketing, Southern Bell Telephone Co. demonstrates a live model of the dish antenna used in Project Echo. **South Texas**—(Photo right) Pictured at the chapter meeting are (L. to R.) Col. A. L. Burke, chapter president; R. W. Henderson, guest speaker; and S. Simpson, a member of the chapter board of directors.



Scott-St. Louis—(Photo left) Shown at the September 8 meeting are (L. to R.) Gen. Harold W. Grant, Commander, Air Force Communications Service; Col. C. W. Evans, USA (Ret.) Military Communications Engineer, Southwestern Bell Telephone Co.; and Walter H. Pagenkopf, AFCEA National and Regional E vice president. **Hawaii**—(Photo right) Shown at a recent meeting are newly elected officers (L. to R.) Maj. T. G. Hayes, USAF, secretary; Capt. R. H. White USN, 1st vice president; Col. J. H. Weiner USAF, president; G. Warren Clark, 2nd vice president; Mrs. Della Pennington, treasurer; and Col. W. B. Bess, 3rd vice president.

Grant's subject was the Air Force Communications Service. He explained that the over-all communications requirements of the Air Force called for worldwide systems thinking and planning. The communications service is fulfilling that need.

Special guests at the meeting were Mr. and Mrs. Walter H. Pagenkopf. Mr. Pagenkopf is vice president of Teletype Corporation, Chicago, Illinois, and a national officer of the Association.

Appointed to the board of directors were: Major General Grant, Colonel Robert D. Easters, USAF, Communications Service, and James C. Barclay, American Telephone and Telegraph Company.

REGION F

Seattle

A dinner meeting was held at the Oval Room, Officers Club, Pier 91, on September 15. Thirty-three members and guests were present.

The next scheduled chapter meeting will be held November 8.

PACIFIC REGION

Hawaii

At a luncheon meeting held September 21 at The Princess Kaiulani Hotel, Honolulu, 75 members were present. Colonel Marter D. Middleton, USA, Chief Defense Area Communications Control Center Pacific, was guest speaker.

Colonel Middleton spoke on the new Defense Communications Agency.

Officers elected for the coming year are: president, Colonel J. H. Weiner, USAF; 1st vice president, Captain R. H. White, USN; 2nd vice president, G. Warren Clark, Mackay Radio; 3rd vice president, Colonel W. B. Bess, USA; secretary, Major T. G. Hayes, USAF; and Treasurer, Mrs. Della E. Pennington, civilian employee of the United States Navy.

Association News

Rear Admiral Bernard F. Roeder Appointed 2nd Vice President

Rear Admiral Bernard F. Roeder, Assistant Chief of Naval Operations (Communications) / Director, Naval Communications has been appointed 2nd vice president of the Association, replacing Rear Admiral Frank Virden.

RAdm. Bernard F. Roeder

Previous to his present assignment, Admiral Roeder was Deputy Director of Naval Communications for the Naval Security Group/Head of the Naval Security Group, Office of the Chief of Naval Communications.

He holds many decorations including the Legion of Merit, with two Gold Stars, and a Letter of Commendation from the Secretary of the Navy for his services in the Pacific early in World War II.

The Association is pleased to welcome Admiral Roeder aboard and publish the announcement of his honorary life membership in AFCEA.

W. Earl Trantham, Jr. Promoted

W. Earl Trantham, Jr. National Treasurer of AFCEA from 1959 to 1961, has recently been appointed vice president in charge of marketing of Emertron, Inc., a subsidiary of Emerson Radio & Phonograph Corporation. He was also named a member of the Emertron Executive Committee.

Major General John B. Bestic, Honorary Life Member

SIGNAL is pleased to announce the acceptance by Major General John B. Bestic, USAF Director of Telecommunications, of an honorary life membership in the Association, recently awarded by the Board of Directors.

Major General John B. Bestic

In August, 1958, General Bestic was appointed Deputy Director of Communications-Electronics, a position which was subsequently redesignated as Deputy of Telecommunications. General Bestic became Director of Telecommunications on July 1, replacing General Harold Grant.

General Bestic holds the Legion of Merit medal with one Oak Leaf Cluster, among other decorations.

(Photo left) Shown at the dedication of Allison Hall, Fort Monmouth, N. J., in memory of the late Maj. Gen. James B. Allison are Miss Allison List, great-grand niece of Gen. Allison as she unveils the building plaque, while Maj. Gen. Ralph T. Nelson, Chief Signal Officer, and Mrs. Eugene List look on. (Photo right) Lt. Commander William W. Deane, USN (Ret.) (right), receives a special award from the American Radio Relay League for his contribution to Amateur Radio Magazine *QST* from Lt. Commander Ray E. Meyers, USN (Ret.). Cdr. Meyers is vice president of Region F, AFCEA.

Headquarters of ADVENT Management Agency Dedicated

Allison Hall, headquarters of U. S. Army ADVENT Management Agency, was officially dedicated at Fort Monmouth September 24. Major General Ralph T. Nelson, USA Chief Signal Officer, delivered the dedication address.

The two-story brick building is named in memory of Major General James B. Allison, a former Fort Monmouth commander and Chief Signal Officer of the Army.

Ten-year-old Allison List, a great grand-niece of General Allison, unveiled the plaque at the dedication ceremony.

General Allison, as Chief Signal Officer, led pioneering in thermal equipment research and development.

The Army ADVENT Management Agency, established at Fort Monmouth one year ago, manages the tri-service Project ADVENT, a priority research and development effort to determine the feasibility of a highly reliable global communication system using active repeater satellites.

General Allison, holder of the Distinguished Service Medal, died on March 18, 1957.

New Signal Corps R&D Chief

Major General Stuart S. Hoff, Signal Officer, USA, Pacific has been recently named Research and Development Chief in the Office of the Chief Signal Officer.

General Hoff, a member of AFCEA, was a civil engineer and an Army reserve officer before being ordered to active duty in 1940. He is a former Commandant of the Army Signal School at Fort Monmouth, N. J., and was Chief of Combat Developments and Operations Division, Office of the Chief Signal Officer.

Colonel Joseph E. Venables Joins SIGNAL Staff

Lieutenant Colonel Joseph E. Venables, Chief, Office of Technical Liaison, Office of Chief Signal Officer, has joined the SIGNAL Staff as a Contributing Editor.

Colonel Venables replaces Lieutenant Colonel Richard W. Dowell.

Prior to his present assignment, Colonel Venables was Assistant Comptroller, Comptroller Division, Office of the Chief Signal Officer.

AFCEA Awards Presented

The AFCEA Award for outstanding scholastic achievement was presented to eight officers graduating with top honors from the U. S. Army Signal School, Fort Monmouth.

Signal Officer Orientation Course: 2nd Lieutenant Jack L. Rosenfeld, Long Branch, New Jersey, Massachusetts Institute of Technology; 2nd Lieutenant Charles F. Anderson, Macon, Georgia, Georgia Institute of Technology; 2nd Lieutenant Thomas J. Eggers, Milwaukee, Wisconsin, University of Wisconsin.

Electronic Warfare Officer Course: Captain James Devage, West Palm Beach, Florida.

Communications Center Operations Course: Warrant Officer Leon R. Mixon, Conyers, Georgia.

Radio Officer Course: 2nd Lieutenant Levi J. Smith, Eugene, Oregon, Oregon State College.

Signal Supply Officer Course: 2nd Lieutenant Roger E. Deshaies, West Long Branch, New Jersey, Northeastern University.

Signal Officer Familiarization Course: 1st Lieutenant James W. McKee, Baton Rouge, Louisiana, Louisiana State University.

Project Mercury Film Available

SIGNAL has recently learned from its friend Kelly Mosley, Regional vice president, Region C, that the Bell System has just released a new film, "A Voice for Mercury."

The film tells how the communication and tracking network for Project Mercury (placing an American astronaut in orbit) was engineered and constructed for the National Aeronautics and Space Administration.

The film runs for fourteen and one half minutes in color, simulating an actual flight of the manned space capsule as seen and heard from the control centers and tracking stations themselves.

Should any chapter or any AFCEA member wish to use this film as part of a program at chapter meetings, Southern Bell Company will be happy to make the necessary arrangements.

General Mauborgne Honored

Major General Joseph O. Mauborgne, USA (Ret.) was honored for his outstanding contributions to the arts and sciences at a reception held during the dedication ceremonies of the new Lavoie Technical Center.

General Mauborgne, a former Chief Signal Officer of the Army, is an honorary life member of AFCEA.

An engraved sterling silver tray was presented to General Mauborgne by Stephen D. Lavoie, president of Lavoie Laboratories, Inc., Morganville, New Jersey.

NEW MEMBERS OF AFCEA

Listed below are new members of AFCEA who have joined the Association during the month of September. Members are listed under the chapter with which they are affiliated. Amateur radio operators are listed with their call letters.

Alaska

Roland E. DeHaven

Arizona

Dale R. Aguilar
Donald L. Erichson
Rudolph W. Liska
Jay T. Suagee

Atlanta

Fred M. Foster
William Davis McJunkin
William H. Young

Augusta-Ft. Gordon

2nd Lt. Marc W. Anthony
2nd Lt. Charlie C. Brown
2nd Lt. Darryl D. Brown
Capt. Richard C. Chabot
Howard L. Chitow
Dr. Richard R. Clifford
S-Sgt. Marvin L. Cruce
SFC Carl K. Davis
SFC John T. Davis
2nd Lt. Gordon H. Dewerth
Lt. Warren E. Fish
Frank H. Cearhart
2nd Lt. John W. Gibbs, Jr.
2nd Lt. Fred G. Glantz
2nd Lt. Martin S. Gordon
2nd Lt. Charles W. Hoffman
2nd Lt. Thomas S. Johnson
SFC Gerald R. King
2nd Lt. Robert L. Lively
Capt. Jack Martin
2nd Lt. Wilbur C. Mosley, Jr.
2nd Lt. Paul E. Nordborg
Lt. Herman L. Ostrow
2nd Lt. Theodore Pappas
2nd Lt. Timothy A. Pellegrino
2nd Lt. Stephen J. Riepe
2nd Lt. Allan C. Rowley
2nd Lt. John L. Ryerson
2nd Lt. David N. Samson
2nd Lt. Lester S. Savitt
SP-5 Robert L. Sims
Ernest O. Smith
2nd Lt. Albert J. Turner, Jr.
2nd Lt. Frank A. Verprauskus
SFC Robert G. Vinson
SFC Johnnie R. Weaver
2nd Lt. Gerald J. White
SFC Merle S. White
2nd Lt. Wayne H. Yunker

Baltimore

J. D. Crowley
Lt. Col. Robert L. Ferguson, USAF Ret.
Melvin E. Grosh
Hugh H. Jones, Jr.
Capt. John H. Schultz, Jr.

Boston

Fred Dale
Paul Henault
Francis Lugi
C. J. Kvasnak
Louis M. Reder

Cape Canaveral

John L. Harpole
John L. Nordbusch
Stanley L. Payne
James B. Murphy
Frank B. Kessler

Central Florida

Frank W. Godsey, Jr.
Fred D. Learey

Chicago

R. Bishop
H. Bleam
K. Brunton
Lt. Col. Francis W. Campbell
A. N. Del Vecchio
P. Huston
Harry W. Rech
J. Yashon

Cincinnati

Paul E. Gotter

Dayton-Wright

Cecil L. Ashley
Lt. Col. L. O. Carroll, USAF
Roland R. Clark
Major Miles L. Glazner, Jr.
K. C. McClellan
Col. R. K. Rhodarmer, USAF
Col. John W. Riggs, USAF
Harold F. Rivero
Lt. Col. R. M. Schulherr
Colvis E. Stark

Ft. Monmouth

Robert M. Benham
William H. Campbell
Major Thomas W. Child
Lt. Col. R. B. Dudley, USAR
Carl T. Engberg
Major R. I. Hughes, Jr., USA
Col. James M. Kimbrough, Jr.
Capt. T. B. Malinowski, USA
Lt. Col. Ted J. Palik
2nd Lt. Kenneth R. Rankin
John D. Strong
Joseph P. Vang

Greater Los Angeles

Douglas A. Dale
John J. Dulin
Robert L. Guaspari
Cmdr. Allyn B. Ostroski, USN

Gulf Coast

Paul K. Argo
1st Lt. Robert N. Bowers
S-Sgt. Charles L. Bunkley
Woodrow W. Cole
T-Sgt. Richard H. Coskey
Major Burl Cowan
Ray B. Dobbs
A-1C Stanley V. Eblen
Donald W. Esco
John N. Foster
Harvey W. Gillette
David E. Graham
Robert R. Greenwood
Leslie N. Grinspoon
Douglas N. Henriques
Gene G. Horsewood
Ruby E. Howery
Major Charles D. Jenkins
M-Sgt. James G. Kilgore
Roy G. Knaak
Sm-Sgt. Johnny E. Lavin
Hal Lewis, Jr.
S-Sgt. Donald L. McCart
Major Donald D. McNelly
M-Sgt. Oliver T. Mode
Clyde E. Myhres
Billy J. Pearson
Henry J. Pyzik
Kathleen M. Rasch
Robert O. Rasch
Marlin W. Rinker
Howard E. Ryan
Max Sumner

Hawaii

Robert E. Dillon
Paul G. Henry
Arthur P. Lebel
Col. Walter A. Simpson, USA
Col. Samuel J. Whitsitt

Kansas City

William B. Foulis, Jr.
Capt. James R. Williams
Lt. Col. Harry Young, Jr.

Lawton-Fort Sill

John A. Stevens
Richard E. White

Lexington-Concord

William W. Eakins
Major Jesse Fishlow, USAF
Joseph V. Haggerty
Robert L. Hamilton
Charles P. Kerber
Irwin J. Metcalfe

London

Clifford G. Bailey
Wing Cmdr. H. Fishwick, RAF
John Margolis
Joseph T. Wiltshire

Louisiana

Warren J. Rourke

Montgomery

William C. Claiborne

New York

John J. Collins
David Kahn
Kenneth Rosenberg
Azriel Rosenfeld
Leslie H. Warner

North Carolina

2nd Lt. C. W. Cloninger, Jr.

Paris

S. M. Bruscantini
R. A. Cochrane
G. C. C. Higgs
J. D. Munns
R. G. Sagnial
P. Shimell
F. Sponzilli

Philadelphia

Frank D. Gray

Philippines

Robert O. Andrews
M-Sgt. M. V. Arbis, USAF
John C. Brown
Capt. Hanover D. Gloria
Maj. Arthur Kugel
Lt. Col. J. F. Lawler, Jr., USAF
Edward S. Raleigh
Maj. John C. Woodward

Redstone-Tennessee Valley

Robert B. Anderson
Vivian D. Armstrong
Richard J. Barefield
William A. Beach
Thomas J. Brewer
James L. Campbell, W4YFN
Milton K. Cummings
William C. Davis
Edith R. Deavers
Gaines P. Gravlee
Sp-4 Cornelius DeJong, Jr.
Don E. Denton, Jr.
John E. Douma
George F. Epps
Larry M. Frank
Charles Gamble
Jack Garrett
Clarence W. Goldey
Jay J. Harris
John E. Hatch, Jr.
Billy J. Hicks
William H. Hill, Jr.
Elve G. Hopkins
Joseph P. Huller
Robert O. Hunter
Larry E. Jensen
Pat Lewis
Rogers C. McCauley
Billie R. McClure
Mel Marine
Albert R. Miles
Robert Murey
Glenn Parker
Raymond W. Plant
Chester R. Savelle
Roy Scates
William Smollen
Robert M. Stewart
William O. Stowe
Roy L. Stutts
Charles F. Tarrer
Frank M. Territo
James W. Turner
Robert J. Ullrich, W4FVD
Chester E. Worley

Rocky Mountain

Warner B. Bair
Capt. R. M. Bruning, USN
James L. Harris
Robert T. Hosken
Lt. Col. F. H. Palmblad
SM-Sgt. Daniel M. Paul
Thomas Simpson
Robert L. Wilke

Rome-Utica

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NEWS ITEMS AND NEW PRODUCTS

Domestic and foreign sales of communications equipment increased about 5 percent during the first half of 1961 over the corresponding period of 1960, the Business and Defense Services Administration, U. S. Department of Commerce has reported. The industry expects a substantial upward trend in sales for the remainder of 1961, which should result in another alltime annual high.

Shipments of communications equipment increased substantially in the first half of 1961, although a slight decrease was anticipated last fall. During the first half of 1961, domestic and foreign sales were approximately 5 percent greater than in the first half of 1960. Since the 1958 recession, communications equipment sales have constantly increased, according to BDSA quarterly surveys: 1958—$2.48 billion; 1959—$2.65 billion; 1960—$2.93 billion; 1961 (est.)—$3.20 billion.

Approximately 30 percent of the total sales were to the Government, mainly for national defense projects.

With the U. S. economy gaining momentum, the outlook for the second half of 1961 is favorable. Annual sales are expected to be greater than anticipated 6 months ago and should reach about $3.2 billion, another peak year for the industry. Export sales should increase correspondingly. In 1961, the industry is expected to purchase well over $1.5 billion worth of materials and supplies from about 40,000 suppliers in more than 3,000 localities. About 90 percent of these suppliers are small businesses, employing less than 500, and are to a large extent dependent upon the economic health of the communications industry.

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United Kingdom exports of electronic products to the United States in the first quarter of this year totaled over $4.5 million, up six percent from the same period of 1960, the Electronics Division, Business and Defense Services Administration, U. S. Department of Commerce, has reported.

Exports of record-playing mechanisms—accounting for over one-half of the total value of exports of electronic products to the United States—increased by 26 percent but exports of record players, radios, and phonographs dropped sharply. A substantial increase in exports of electron tubes was offset by a decline in exports of communications, navigation and radar equipment.

United Kingdom exports of electronic products to all countries during January-March, 1961, totaled $48.7 million, a 26 percent increase over the $38.5 million total in the first quarter of 1960. The United States was the largest single market, followed closely by Canada ($4.3 million). Other principal markets were the Netherlands ($3.9 million), Indonesia ($2.5 million), West Germany ($2.4 million), and Australia ($2.2 million).

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Major organizational changes and top-level appointments in the National Aeronautics and Space Administration have been announced. James E. Webb, NASA Administrator, said the changes were keyed to the nation's accelerated civilian space program, including manned lunar exploration, and have two major objectives. These are: Realignment of the headquarters technical program offices to provide clearer focus and greater emphasis on NASA's major programs, and to provide directors of NASA's research and development centers an increased voice in policy making and program decisions.

Personnel changes, effective November 1, include appointment of: Ira H. Abbott, as director of the Office of Advanced Research and Technology; Dr. Homer E. Newell, as director of the Office of Space Sciences; D. Brainerd Holmes, as director of the Office of Manned Space Flight Programs.

Thomas F. Dixon, named last August as director of NASA's Office Launch Vehicle Programs, has been appointed Deputy Associate Administrator. Dr. Abe Silverstein, former director of the Office of Space Flight Programs, was appointed director of the Lewis Research Center, Cleveland, Ohio and Robert R. Gilruth, former director of Space Task Group, Langley Field, Virginia, was appointed director of NASA's new Manned Spacecraft Center, Houston, Texas.

The changes place new emphasis on four major areas: Manned space flight, including lunar exploration; Space sciences, in terms of unmanned scientific investigation of space, the moon and the planets; Practical applications of space technology, including operational weather and communications satellites; and, Advanced research and technology in both aeronautics and space.

Program office directors will report to the Associate Administrator, Dr. Robert C. Seamans, Jr. Within his particular program area, the director of each of these four offices will have over-all responsibility for the various projects being carried out by the agency. Program directors will establish technical guidelines, budget and program funds, schedule each project and evaluate progress.

The Office of Manned Space Flight Programs will have the responsibility for over-all systems engineering and evaluation for the various manned space flight projects, including the spacecraft, launch vehicle, ground support equipment, tracking stations and communications network. Each of these elements must be designed and developed with the proper relationship to the other elements.

The new organization plans integrate the present responsibilities of the Office of Life Sciences into each of NASA's programs. Aerospace medicine will be a responsibility of the Office of Manned Space Flight; space biology, the Office of Space Sciences; and advanced life support systems, the Office of Advanced Research and Technology.

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Ultrasonic waves have been amplified directly in a piezoelectric semiconductor crystal by Bell Telephone Laboratories scientists. The sound waves are amplified by interaction with electrons drifting in the crystal, in much the same way that electromagnetic waves are amplified in a traveling wave tube.

Drs. A. R. Hutson, J. H. McFee and D. L. White have reported in the September 15, 1961 issue of *Physical Review Letters* that they have amplified an ultrasonic wave traveling through a crystal of cadium sulfide by applying a d.c. electric field in the direction of wave propagation. They observed gains of 18 db in a 15 megacycle wave and 38 db in a 45 megacycle wave traveling through a 7mm length of CdS.

The amount of amplification ob-

tained depends on the applied voltage and the conductivity of the material. CdS was used in the experiment because large single crystals are available which are strongly piezoelectric and have the required semiconducting properties. Since CdS is also photoconductive, the conductivity can be adjusted to just the right value for amplification by shining light on the crystal.

Direct amplification of high frequency sound waves is possible because a sound wave traveling in a piezo-electric material produces a longitudinal electric field which travels along with the wave. If the material is also conductive, the electric field will cause currents to flow in the material. Because the piezoelectric field is periodic the electrons tend to interact with the piezo-electric field and consequently react back on the material changing the velocity and amplitude of the sound wave.

D. L. White conceived the idea that if a d.c. electric field is impressed on the material, so that the bunched carriers are made to drift in the direction of wave propagation faster than the speed of sound, the sound wave will be amplified similarly to the way electromagnetic waves are amplified in a traveling wave tube.

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Design of the Syncom communication satellite is near completion, NASA has announced. Syncom is an experimental active repeater communication satellite to be placed in a 24-hour orbit. It is to be launched from the Atlantic Missile Range at Cape Canaveral, Fla. in late 1962. Syncom will be used to relay telephone and telegraph communications over near Hemispheric distances. Early Syncom will not have the capability to relay television signals.

Syncom will be cylindrical, 25 inches high, 28 inches in diameter and weigh about 55 pounds, excluding an attached solid propellant rocket motor. This motor, called the apogee motor, will be used to inject the space-craft into a circular near-syncronous orbit when the Syncom reaches apogee (22,300 miles) of the trajectory into which it is boosted by the three-stage Delta vehicle. In addition, 10 small vernier rockets will be used to further correct the final velocity. Two nitrogen jets, will be employed to attain and maintain required orientation and position. One jet is located on one end of the spacecraft about 12 inches to one side and thrusts paralleled with the spin axis. The other jet is located in the side of the cylinder, and thrusts perpendicular to the spin axis. Solar

genus: homo • species: sapiens discipline: factors engineering

At the six major RCA Defense Electronic Products facilities, teams of psychologists and design engineers are deeply involved in the highly specialized, incredibly complex study of human factors engineering—man/machine interfaces, auto-instructional methods, decision processes, read-in/read-out optimization techniques, sensory perception, the entire spectrum of psychological-physiological-physical disciplines. Whether your requirements involve human factors study of command and control functions for defense networks, or projected life support systems for space exploration, a total RCA capability stands ready to assist you . . . from feasibility study to project completion. Write Defense Electronic Products, Radio Corporation of America, Camden, N. J.

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sensing cells, located on the side of the cylinder, provide information via telemetry, in real time, from which necessary adjustments in orbiting and orienting the satellite will be made by command from the ground.

The shell will carry an array of 3960 solar cells to supply power and charge nickel-cadmium batteries which will power the satellite's instrumentation when it is not in sunlight. The system is designed to give the Syncom a working lifetime of one year, supplying 20 watts of power at 27.5 volts.

There are duplicate telemetry and communication systems (including command systems). The communications system operates on a power of 2 watts. A slotted array antenna projecting from one end of the craft will receive and transmit the telephone and telegraph communications. Telemetry will be transmitted via four whip antennas. These are attached at the opposite end of the craft, projecting outward 90 degrees apart in turnstile fashion.

Communications signals, telephone and telegraph, will be sent to the Syncom on a frequency of 7500 mc. The signal will be amplified by a lightweight traveling wave tube and retransmitted to the ground on 1850 mc. Telemetry will be transmitted on 136 mc. In addition to relaying "real time" data on the attitude of the satellite, information will be telemetered relating to the solar cells, the communication systems, jet reaction time and spacecraft temperature.

Syncom will be stabilized in orbit by spinning it like a gyroscope. Its spin axis will be perpendicular to the plane of its orbit and generally will be North-South in relation to the earth. Spinning, with the cylindrical part of the spacecraft always facing earth, the satellite will transmit a circular beam with its edge always toward earth.

Syncom will be placed in a 22,300 mile orbit synchronous with the rotation of earth. The first series of satellites will not be in stationary orbits, but will move in an elongated figure 8 pattern 33 degrees north and south of the equator over a given longitude over the Atlantic Ocean during its 24-hour period. To achieve this orbit, properly orient the satellite and maintain its attitude, a special control system will be employed which was developed by the Hughes Aircraft Co. for a lightweight spacecraft.

The Syncom control system will be employed after the Delta has spun up to about 160 rpm and boosted the spacecraft to synchronous altitude.

This should occur off the southeast coast of Africa about 5½ hours after launch. The apogee rocket motor then will be fired to give the vehicle sufficient velocity to place it in a nearly circular synchronous orbit.

Hughes is under contract with NASA to build at least three Syncom satellites.

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An installation for ground-based explorations of upper atmosphere and outer space is being constructed by the National Bureau of Standards Boulder Laboratories and the Instituto Geofisico de Huancayo (Peru) at a site 17 miles east of Lima, Peru. The Jicamarca Observatory will have, when completed, a 6-million watt pulse transmitter and a 22-acre antenna with 9216 crossed dipoles mounted 6 feet above a reflecting ground screen. The antenna will be used to transmit a very high frequency wave lasting from 50 to 1500 microseconds, and when switched to the receiving state, to detect the faint re-radiation of the pulsed radio wave by free electrons in the upper atmosphere.

Employing this scatter radar technique developed by K. L. Bowles of the Bureau's Central Radio Propagation Laboratory, the Observatory will be used in the measurement of: Electron densities at heights from 100-3000 km; the kinetic temperature of the ions, 200-3000 km; the percentage composition of major ionic components, 200-700 km and 1200-1800 km; and the intensity of the earth's magnetic field. It will also be used in limited observations of radar echoes from the sun's corona and from solar gas clouds emitted by solar disturbances, in studies of small-scale irregularities in the outer atmosphere and in studies of the D-region of the ionosphere, particularly its turbulence and meteorology. Other applications include the calibration of satellite instrumentation, and searching for radio stars one magnitude weaker than those observed to date. The full 6 Mw transmitter is expected to be operational in December 1961.

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Raytheon Canada, Limited, has developed a low cost method to relay radar pictures via ordinary telephone lines instead of through video/microwave links. Developed under a contract from the Canadian Department of Transport, the technique which can be used with all types of radar presentation, will make it economically possible for flight controllers to visually hand-on control of a plane from one control center to the next

as the craft flies between cities.

The radar signals are fed into a "scan-converter" developed also by Raytheon Canada, which stores the information and converts it into a form usable on telephone lines. The information sent over the telephone line is revised once every 40 seconds, whereas the radar image fed into the "scan-converter" is updated about every 10 seconds. Bandwidth of the signals transmitted is less than 3000 cycles and about 500 times less than the base band required to transmit radar/video over a microwave relay or coaxial cable.

On the receiving end, the telephoned signals are reconverted into a television type display and viewed on a conventional receiver.

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Kearfott Division of General Precision Inc., Van Nuys, Calif., is marketing a new commercial ATC L-Band transponder test set. The set, in conjunction with a suitable oscilloscope, checks out any transponder the company reports—two pulse, three pulse, or combinations—built in accordance with ARINC 532C. Through amplitude control of each pulse in the interrogation train, the unit also checks out the side lobe suppression features of the system.

The set simulates all ATC Beacon and Military interrogation modes, simulates two or three-pulse interrogation with side lobe suppression, and is compatible to ARINC 532C specification.

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A semiconductor microwave switch for C-Band applications has been developed by RCA's Aerospace Communications and Controls Division, Defense Electronic Products.

The switch, developed under the sponsorship of the Advanced Research Projects Agency, has an average power handling capability of two watts at the design frequency of 5585 megacycles, with an insertion loss of less than 2 decibels from 5000 to 5900 mc. Isolation is greater than 50 decibels over the same range, and rise and fall times of the output pulse are less than 0.1 microseconds.

The RCA switch, having passed all MIL-E-5400 environmental tests, presently is available for C-Band applications only. However, models capable of operating at other frequencies are under development. Use of the switch as an electronically controlled attenuator also is being considered.

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The Univac Military Digital Trainer, a desk-size binary computer, has been introduced by the Univac Military Department, St. Paul, Minn., for applications ranging from training in computer maintenance, design and programming to the solution of data processing problems.

The portable unit occupies eight cubic feet of space and operates from 60 cycles, 110V AC power, dissipating a maximum of only 750 watts of electrical power.

The computer has a high-speed magnetic core memory with 512 fifteen-bit words of random access storage with a read-restore cycle period of 8 microseconds, add time of 24 microseconds and multiply-divide time of 130 microseconds.

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Hallicrafters Company has developed a light weight, Wideband High Intercept Probability (WHIP) receiving device for reconnaissance satellites, airborne and "expendable jamming" ground electronic warfare systems and laboratory RFI uses. The company reports the WHIP receiver detects radio-radar signal frequencies to within 1 percent without tuning.

The device provides the frequency determining features of the superhetrodyne or tuning receiver and the 100% intercept probability of a crystal video receiver, both basic receiver types currently used in these applications. With the WHIP receiver all frequencies within its band can be identified within 1 percent simultaneously. The discriminator design employs passive sections and diode detectors. Active power consuming RF devices of the tuning receiver such as the klystrons, magnetron, voltage tunable magnetrons and the backward wave oscillators are not needed since the passive frequency-determining elements of the WHIP require no power.

The basic WHIP receiver consists of the low-cost passive frequency discriminator (including two matched detectors), with or without preamplifier, whose output can be displayed visually on a calibrated CRT or any properly calibrated oscilloscope. Frequencies are read out as angular lines in a manner similar for instrument pointers.

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A mobile, compact Ionospheric Sounding System has been developed by Philips Electronics Industries Ltd., Toronto, Canada. An advanced version of equipment that has been tested on a variety of research projects in the U. S. and Canada, the new equipment is completely automatic and fully compatible with existing systems the company reports. The Sounder Transmitter and Receiver

Units weigh approximately 600 lbs. each and measure 42 inches wide by 52 inches high.

Applications of the equipment include vertical and oblique incidence sounding for H. F. communications reliability, ion trail detection, propagation research and panoramic radar. Both frequency and time programming facilities permit pre-selection of automatic programmed frequency sweeps. Particular band of frequencies of special interest within the spectrum are scanned at 100 kc increments and the rest of the spectrum rapidly at 1 mc intervals.

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A new infrared spectrometer developed by Block Associates, Inc., of Cambridge, Mass., is described by the company as being compact, lightweight, having low power requirements and only one moving part. The spectrometer consists of an optical head and separate electronics. It is available with a selection of IR detectors and optics which can be used to meet a variety of spectral requirements. If desired, two different detectors can be used in tandem to increase the spectral coverage of the instrument.

Power requirements are 115 v A.C. 10 watts; output is 0 to 5 v and output impedance is 1000 ohms resistive. Spectral range of Model I-4S is 0.35 to 3.0 μ. Range of Model I-4T is 1 to 16 μ.

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Westinghouse Research Laboratories have developed a superconducting magnet which weighs one pound and produces a magnetic strength, or flux density, of 43,000 gauss (43,000 lines per sq. centimeter). The doughnut size magnet runs from an ordinary automobile storage battery. The only power the battery continuously supplies is a few watts to overcome the small losses in the wires leading to the magnet.

The new magnet is wound from a wire which is a superconductor. About 5000 turns of the threadlike wire (of niobium-zirconium base alloy) are wound into a coil or solenoid, two inches in diameter, one and one-half inches long. The coil is immersed in a vessel of liquid helium which keeps it at a temperature near —450°F. The energy required to cool the coil is only a fraction of that needed to create a comparable magnetic field with a standard electromagnet.

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A miniature converter for use in servo amplifier systems, computers, telemetry and multiplexing equipment is being marketed by Minne-

apolis-Honeywell Regulator Company.

Less than two inches in height, the converter (Model 725170) is reported to have an extremely low noise level due to special magnetic shielding and isolation of the driving coil from the contact circuit.

The converter plugs into a standard nine-pin miniature socket. Coil power is supplied through pins on the top surface with a special connector supplied with the converter. Minimum life expectancy in normal applications is 10,000 hours, Honeywell said.

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A digital serial memory with pulse delays ranging from 20 μsec to 100 μsec at operating frequencies of 8 to 16 mc is now available in a self-contained plug-in package from Computer Control Co., Inc., Framingham, Mass. Designated the SM-40, this unit provides storage as high as 16 megabits per second, without the need for carrier modulation. The package contains all necessary input-output logic and is compatible with existing Computer Control Company H-PAC digital modules.

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General Electronic Laboratories, Inc., Cambridge, Mass., has developed a Voice Interference Analysis Set to accurately measure the intelligibility characteristics of any type of voice communication system. The unit is designed to evaluate phone lines, transmitter-receiver links, tape recorders, intercom sets, PA systems and similar voice communication channels.

In operation, a sub-unit generates a triangularly modulated tone at the input of the communication channel. This tone is fed from the output of the channel into the Voice Analysis Set. The resulting signal is processed and divided into fourteen frequency bands which are summed logarithmically and digitally read out. The result is a number called the Articulation Index—a measure of the intelligibility of a transmitted speech message under the existing conditions. Test time is approximately 30 seconds.

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The KM Mark 2 is an improved version of the existing KM series of Cannon miniature plugs manufactured by Cannon Electric Co., Los Angeles. The KM Mark 2 offers through-grommet insertion and extraction of contacts for wiring and maintenance simplicity and also exceeds all requirements of Mil-C-25955.

The insulator-grommet is an integral design eliminating the possibility of a void between the insulator and the grommet. Contacts are inserted without removing the grommet.

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A Twistor Memory Module has been developed by Automatic Electric for future electronic telecommunications systems.

The memory stack employs a new method for using the twistor principle in a semi-permanent memory. Semi-permanent storage is accomplished by coding a "virtual solenoid" (made of a printed-circuit conductor and a sheet of copper) which encloses the twistor elements. By pulsing through the printed-circuit conductor, an eddy current is induced in the copper sheet. The twistor elements then see a flux density of sufficient strength to disturb them. If a hole has previously been punched in the copper sheet at a particular bit location, the flux density will be insufficient to disturb that twistor element. Thus, the semi-permanent storage, at any given "one" or "zero" bit location is governed by the presence or absence of a hole in the copper sheet.

Coding can be changed by sliding

the plug-in solenoid from its shelf and replacing it with another.

The twistor array developed at Automatic Electric is a 16 plane stack; each plane having eight words of 60 bits per word. Larger storage capacity can be had by increasing the number of planes in a stack or connecting a series of stacks. The minimum "one" output from an 80 mil bit length is 15 millivolts.

The twistor is composed of a copper wire, about the diameter of a human hair, helically wrapped with a flattened permalloy wire. Tiny segments of this permalloy wire act as permanent magnets. If a segment of the permalloy wire is magnetized in one direction, the bit read-out is a binary "one"; if the polarity is reversed at this bit location, it is a "zero."

The twistor wire provides both sense and access means for stored information. For noise reduction, each twistor is paired with a plain copper wire to form a transmission pair. A series of five-turn printed-wire solenoids are placed at right angles to the twistor pairs. An intersection region of one twistor with one solenoid represents a storage location or bit. All of the bits along a single solenoid make up one word.

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A television video system operating 250 miles above the earth is being developed to give NASA a view of a proposed space craft being hurled from its rocket booster. John G. Brooks, president of The Siegler Corporation, has announced that a complete video system—both spaceborne and ground—will be designed and built by his company under an initial $300,000 contract from NASA's Goddard Space Flight Center. The system will be used for the launching into test trajectory of an Echo A-12 prototype test payload.

The camera will provide close-up views of the balloon from the time of ejection from the carrying canister throughout the test trajectory. Information transmitted back to earth by the system will be permanently recorded on film and magnetic tape.

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A method for raising the frequency ceiling of around-the-world communications by 50 times is under development at the Sperry Gyroscope Company.

In an effort to expand the ionosphere's natural ability to reflect low frequency radio waves, Sperry microwave scientists call "promising" the artificial fertilization of this region of the earth's atmosphere to make it bounce signals as high as 200 megacycles.

Successfully employed, this technique could create broadened bandwidths required for intercontinental television and assure telephone and radio transmission channels to relieve crowded existing facilities.

Portions of the ionosphere would be seeded with a rocket-borne chemical such as cesium and then pairs of frequency-controlled, high-intensity microwave beams would be aimed to fertilize the seeded areas. Sperry reports that single applications of the chemical-microwave energy combination may boost and sustain for several hours a level of ionization that could bounce signals at the higher frequencies. Cesium powder, spewed from the rockets in small quantities, simply disintegrates and disappears after a short period of time.

Alternate plans would require launching cesium rockets every half hour or pumping microwave energy of one frequency into the ionosphere at such tremendously high power that huge transmitter installations would be needed.

Simultaneous firing of a pair of microwave beams into the ionosphere at selected frequencies is expected to allow the use of smaller transmitting antennas at significantly less power to obtain the highly directional energy required to sustain ionization. Two beams could be transmitted from a single antenna, Sperry believes.

• • •

Burroughs Corporation demonstrated a completely miniaturized working electronic computer capable of performing calculations at speeds of a room size computer last month in Washington, D. C.

The operating model was built to show how a new method of miniaturized computer construction makes it possible to shrink a commercial computer from room size to desk size. The computer has a single-purpose brain that could solve many single-purpose commercial or military problems calling for computer speeds.

The model demonstrated was built to prove out the new packaging construction method. Design of the computer was aimed for the production of a practical miniaturized computer built from conventional commercially available components and capable of dissipating the heat generated by the components.

The packaging system utilized in the computer is termed Macro-Module. The model built through

use of this system is technically a working "digital differential analyzer," Burroughs states. Called MADDAM (from Macro-Module and Digital Differential Analyzer Machine organization), the computer has 5,500 components housed in a space measuring 3 x 6 x 11 inches and a component density of 69,000 components per cubic foot. The computer weighs 12 pounds and can perform 33,000 mathematical calculations per second.

The Macro-Module method has a finned heat exchanger as a central element in a row of triangular chips. The chips, approximately three-eighths inch thick and the height of a half-dollar contain electronic circuitry and plug into a folding printed circuit board. Additional compactness is obtained by folding the board holding the upright chips around the heat exchanger. Two such rows of chips each three inches square and ten inches long, contain the circuitry, logic, memory and other working parts of the computer.

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A new "tropospheric scatter" communications antenna has been developed by The Boeing Company's Antenna Department. The company reports voice, television and numerical symbols, such as computer data, can be sent as far as 500 miles without signal boosters between points through such antennas.

By positioning reflectors strategically on ocean islands and specific points of land masses, instantaneous, world-wide communication, including television, is possible the company believes.

Available with reflectors 30, 60 and 120 feet across, the antenna is assembled on site. Pre-formed and pre-drilled steel girder construction reduces installation costs by as much as $5,000 per 60-foot antenna and parts can be color-coded to enable unskilled, non-English speaking workers to assemble the system.

The company has announced sale of a 30-foot system to Page Communications Engineers, Inc., for use in overseas installations for Army communications.

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Handbook for the Prediction of Shipboard and Shore Electronic Equipment Reliability is the title of Vitro Laboratories Technical Report 133, NAVSHIPS 93820, recently completed for the Navy's Bureau of Ships.

The Handbook is slated for distribution by the Navy to government and military personnel and to civilian contractors working on Navy projects.

Author of the Handbook is Ralph G. Stokes, supervisor of the Laboratory's engineering study group.

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A solid-state Telemetrol system, which can connect up to 32 satellite stations to a central facility via two-wire party line, or, with additional party lines that can connect as many satellite stations as desired, is described in a new brochure being offered by Daystrom, Incorporated, Control Systems Division, 4455 Miramar Rd., La Jolla, California.

System functions include continuous scanning of multiple groups of input points per satellite; rapid operator alert of off-normal conditions at satellite stations before danger point is reached; supervisory control of remote functions; double transmission for error-free messages; verify-before-execute for proper control action; permanent records of scan cycles.

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The following reports are available from the Office of Technical Services, Business and Defense Services Administration, U. S. Department of Commerce, Washington 25, D. C.

Design Objectives for Telemetry R-F Transmission Links for the Period 1960 to 1970, by T. Jackson, Missile Systems Department, Naval Ordnance Laboratory, for the Navy Department, January 1961. Order No. PB 171-690 for 75 cents.

A State-of-the-Art Survey of Electronic Delay Techniques, by J. Brauer and K. Stiefvater, Rome Air Development Center, USAF, September 1960. Order No. PB 171-420 for $1.25.

Ordnance Engineering Design Handbook, four parts, Duke University for Office of Ordnance Research, Army Department, May 1961. This series is a complete course of instruction in the theory, components and system design of servo-mechanisms. Order No.'s: PB 171-480 at $3.50; PB 171-481 at $2.75; PB 171-482 at $3.50 and PB 171-483 at $3.

Supplement No. 3, Patent Abstract Series describes Government owned patents now available for license at no charge by private firms and individuals for non-exclusive use. The series lists patents released for licensing between July 1958 through December 1960. The series includes seven booklets some of which are: *Instrumentation,* Order No. PB 171-672 for $1; *Metal Processes and Apparatus, Machinery and Transportation Equipment,* Order No. PB 171-675 for $1.25; *Electrical and Electronic Apparatus,* Order No. PB 171-676 for $1.75.

Results of the International Geophysical Year, translated from Ukranian language mono., *First Results of the International Geophysical Year,* 1959, Kiev, USSR by V. P. Tsesevych. Order 61-11941 at $1 per copy. This Soviet monograph on the IGY is divided into five main parts in addition to an introduction and an appendix. These parts discuss meteor research, luminous clouds, the earth's magnetic field during the IGY, cosmic rays during IGY and conclusions.

Photoprogress

Brig. Gen. George W. Goddard, USAF (Ret.), Special Assistant to Itek Laboratories' President John H. Carter, was honored recently at a testimonial luncheon by the Society of Photographic Instrumentation Engineers for long and outstanding contributions to the advancement of the science of optical recording, measurement and identification as employed in military aerial reconnaissance. Itek Corporation announced the creation of a General Goddard Award to be sponsored by Itek and awarded annually by SPIE to the person making the year's most outstanding contribution to aerospace photo-optical instrumentation.

General Goddard has recently patented an aerial camera to take automatic photographs of a nuclear bomb explosion for ground tests and from military aircraft dropping the bomb. The camera is designed to make a series of high-speed pictures by the light of the flash, before the mushroom cloud of the shock wave obscures the ground target area. The patent was assigned by Gen. Goddard to Bulova Research and Development Laboratories, a division of the Bulova Watch Co., New York.

General Goddard has served as Director of Research and Development for the Air Force and as Director of Reconnaissance for NATO.

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A high speed system for printing identifying material on aerial photographs is being utilized by the Air Force in reconnaissance missions. A major component of the system, the "Rapid Automatic Film Titling Unit," was designed and produced by Photomechanisms, Inc., in collaboration with Eastman Kodak Co. and Xerox Inc. for Melpar Inc. The titler was designed as part of a complex electronic ground data handling

system for the Convair B-58 Weapons System.

As the film passes through this device at rates from 15 to 25 feet per minute, data which has been recorded on tape from the aircraft's instruments may be analyzed, selected and printed permanently on the film at a rate of 170 characters per second. Films in width of 9½ in., 70mm and 35mm can be accommodated.

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A motion picture recording technique which permits observation of the interior motions of an explosion which can only be inferred from external photographic records has been developed by the U. S. Naval Ordnance Laboratory.

Devised by NOL's Explosion Dynamics Division, the technique provides rapid visualization of the solutions to explosion dynamic and flow problems with an electronic computer. Each explosion and shock problem submitted to the computer for solution is set up as a grid system in which the intersecting points correspond to positions in the actual explosive system. Detonation is affected mathematically and the computer calculates and collects numerical data representing the motion of the grid points. Periodically, the new positions of all the calculated points of the grid system are simultaneously displayed as dots on an oscilloscope screen and photographed in a frame sequence.

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Industrial Products Division of Fairchild Camera and Instrument Corporation has announced an identification camera which will provide Polaroid 10-second prints in a choice of six different formats.

Called the Fairchild-Polaroid F-430, the new camera is adaptable to any identification picture requirement, a company spokesman reports. By making minor adjustments, the user is able to obtain the following formats: four identical pictures of one subject; two pairs of two different persons; front and profile of one person, head only; front and profile of one person, ¾ body; four different poses of one person; and individual photos of four individual persons.

The camera uses regular Polaroid Land roll film and is equipped with the picture shifting mechanism, 90-mm f/3.5 lens mounted in Alphax shutter, close-up lens, sliding mask, stereo time and Polaroid film back. Shutter speeds are from one second to 1.25 second.

Names in the News

Donald C. Alexander was recently elected vice president-engineering of Suprenant Manufacturing Co., a subsidiary of International Telephone and Telegraph Corp.

Brig. Gen. Peter C. Sandretto has been selected to participate in a special staff visit to observe Air Force operations in Europe. He is employed as deputy executive, International Telephone and Telegraph Corp., U. S. Defense Group, Nutley, N. J.

Col. James O. Vann, USAF, has been named Commander of the Armed Services Technical Information Agency.

Don A. Christensen and **Todd G. Alexander** have been elected to the board of directors of Cal-Val Research & Development Corp., Woodland Hills, Calif.

Philip B. Taylor has been elected to the board of directors of General Precision Equipment Corp.

Alfred J. Pote has been elected senior vice president and assistant to the president of Page Communications Engineers, Inc.

James H. Thompson was recently appointed vice president-general manager of the Industries Div. of Chicago Aerial Industries.

Dr. Charles M. Herzfeld and **William A. Wildhack** have been appointed associate directors of the National Bureau of Standards.

Dr. Jan A. Rajchman has been appointed director of the Computer Research Laboratory, David Sarnoff Research Center, Radio Corporation of America.

Neil P. Whitney has been named president of Aircraft Radio Corporation.

Winton B. Medlar has been elected president of the Professional Photographers of America, Inc.

Albert Sikorsky has been named manager of government relations of General Instrument Corp.

Merle W. Kremer has been appointed vice president of the Electronic Tube Div., Sylvania Electric Products.

Calvin A. Gongwer has been named vice president, special projects of the Global Marine Exploration Co.

Arthur R. Von Hippel has been elected vice president in charge of Fundamental Materials Research of U. S. Sonics Corp.

Albert H. Cohen has been appointed vice president and chief operating officer of Metrex Electronics Corp.

Lawrence I. Algase has been promoted to director of engineering, Instruments for Industry Inc.

James Hollis and **Gordon Frederick** have been elected directors of White Electromagnetics, Inc.

John J. Connolly has been promoted to vice president of Litton Systems, Inc., and general manager of the Data Systems Div., Litton Industries.

Dr. Thomas L. Gresham has been elected vice president of Air Products and Chemicals, Inc.

Ralph I. Cole of Melpar, Inc. has been made Director of a new corporate Government Project Service Office which will be established in the Washington area.

Gordon S. Burroughs is president of the Burroughs Electronics, Inc., Cos Cob, Conn., a recently formed R&D organization conducting studies in radio direction finding, aerial navigation, infrared, reconnaissance, surveillance and analog computers.

STATEMENT required by the act of Congress of August 24, 1912, as amended by the acts of March 3,1933, July 2, 1946, and June 11, 1960 (74 Stat. 208) showing the ownership, management, and circulation of SIGNAL Magazine, published monthly at Washington, D. C. (additional entry, Baltimore) for October 1961.

District of Columbia }
City of Washington } ss.

1. The names and addresses of the publisher, editor, managing editor are:

Publisher: Armed Forces Communications and Electronics Association, 1624 Eye St., N. W., Washington 6, D. C.

Editor: W. J. Baird, same address.

Managing Editor: Judith H. Shreve, same address.

2. The owner is: (if owned by a corporation, its name and address must be stated and also inmediately thereunder the names and addresses of stockholders owning or holding 1 per cent or more of total amount of stock. **If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.)**

Armed Forces Communications and Electronics Association, 1624 Eye Street, N. W., Washington 6, D. C.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are:

None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as **trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also that the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.**

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during 12 months preceding the date shown above was: (This information is required by the act of June 11, 1960 to be included in all statements regardless of frequency of issue.) 11,538.

W. J. BAIRD,
Editor.

Sworn to and subscribed before me this 26th day of September, 1961.

(Seal) KATHERINE SCHORREMANS
Notary Public.

(My commission expires Feb. 14, 1965.)

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- SIGNAL gives its advertisers an opportunity to present facts about services, products and achievements to a specialized audience.
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